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NEW YORK, SATURDAY, MAY 25, 1912.

CONTENTS.

Editorials 1095
Annual Meeting of the A. I. E. E..... 1098
Bust of Joseph Henry Presented to the Associazione Elettrotecnica Italiana 1098
Government and the Aluminum Interest..... 1099
Westinghouse Annual Report..... 1099
National Fire Protection Association..... 1100
Schenectady Meeting of the A. I. E. E..... 1101
Underground Conduits..... 1104
Proposed Ordinance to Regulate the Damage from Electrolysis..... 1105
Public Service Commission News..... 1106
Current News and Notes..... 1107
Largest Central Station in the State of Kansas..... 1109
Adjustable Speed Motors.—II. By Alexander Dawes DuBois..... 1113
Pressure Coefficients of Electrical Resistance. By A. A. Somerville.. 1118
Farmer Service Near Fort Wayne, Ind..... 1120
Central-Station Building at Lowell..... 1120
Flat-Rate Controller Campaign at Marion..... 1120
Louisville New-Business Methods..... 1120
Heating of Rolls for Paraffining Paper..... 1120
Comparative Illuminants 1120
Operating Costs of Diesel Engine Plants..... 1121
Relation Between the Company and the Public..... 1121
Meat Saved Pays Cost of Electric Cooking..... 1122
Induction Motor Wiring. By H. B. Foote..... 1122
Display and Indirect Lighting..... 1123
Do Lamps "Overshoot" in Candle-Power? By Evan J. Edwards..... 1124
Recent Telephone Patents..... 1124
Letters to the Editors:
High-Speed, Uniflow Steam Engine. By John Davidson..... 1125
Wireless-Telegraphy Standardization. By W. V. Hensgen..... 1125
Digest of Current Electrical Literature..... 1126
Book Reviews..... 1130
New Apparatus and Appliances..... 1131
Industrial and Financial News..... 1134
Personals 1137
Weekly Record of Electrical Patents..... 1144

THE MEDIUM-SIZED PLANT.

Those of our readers who are interested in central-station design will find considerable food for reflection in the description of the Wichita central station elsewhere in our columns. Although it happens to be the largest central station in Kansas, it is a modern typical installation of medium output, being rated at 8000 kw. To design a station of this size is less easy than the ordinary engineer would assume at the first thought, for it is neither small enough to be virtually a one-man plant nor large enough to be treated from the standpoint of heavy central-station engineering. In this particular instance the plant apparently was started out for the goal of great simplicity but fell slightly short of it. It has not reached, however, the intricacy of a large central station and still remains sufficiently simple, thanks to its oil and gas firing, to be handled at a pinch by two men and easily by three. The equipment is in its items thoroughly modern, and in principle up to date so far as the local conditions permitted. A 250-500-volt commercial motor circuit seems rather an anachronism in these days, nevertheless. The operation of a mixed service in plants of moderate capacity leads in the long run to very undesirable conditions. In many instances it would pay a company to go to large expense in unifying its service rather than to become more and more heavily involved in an intricate combination of different kinds of service, which means increased cost at the station. However, considering this disadvantage, the Wichita station has been worked out with unusual success. Its main generating equipment consists of two 4000-kw turbines of the latest pattern, working at 2300 volts, three-phase, and delivering energy for general local service, for motors and railway through motor-generators and for a high-tension transmission line to neighboring towns. So small a number of generating units, although here temporarily reinforced by a 750-kw auxiliary, may seem at first sight like taking too many chances, but the advent of the turbine has put a new face on plant design since the overload range of these machines when rated with reasonable conservatism is extraordinarily large. The emergency range, therefore, rests in the overload instead of in a separate machine with small overload range. It is to be regretted that there seems to be a growing tendency to rate generators at their extreme output which somewhat complicates the reserve range situation.

In general, the Wichita station as actually constructed bears close resemblance to the usual station of several times the size. Perhaps the thing which most strikes the Eastern engineer in its design is the abandonment of coal as fuel. There is, to be sure, future provision wisely made for coal bunkers if they should become necessary, but at present the boilers are fired with natural gas, with fuel oil as a reserve. Nominally each boiler is operated by twenty-nine 6-in.

natural-gas burners, but storage space for 30,000 gal. of oil is at hand in an outside tank and fuel can be pumped to special oil burners if the use of this auxiliary fuel should become necessary.

Interesting tests have been made with respect to the use of natural gas and oil, of which the apparent result is rather in favor of the natural gas. With the oil burners in use the thermal units per kilowatt-hour were increased nearly 15 per cent. How much of this increase was due to difference in the burning conditions for the two fuels and how much to allowances due to the energy necessary for maintaining the oil feed one cannot say without going into the details of the test. The general results, however, go to confirm a considerable mass of testimony already accumulated regarding some of the practical difficulties in burning fuel oil economically. Theoretically the heating power of fuel oil is very high. In every-day working its advantage over coal in point of efficiency is less than one would suppose, and the advisability of using the oil is a matter which must be investigated pretty thoroughly with respect to local prices before a sound judgment can be made. Oil and gas, however, are ideal fuels for city central stations, on account of the suppression of the smoke difficulty, and their use deserves to be encouraged by the public at large.

The subsidiary equipment of the Wichita station is in general of conventional modern type. An interesting feature of the plant, however, is the transmission work undertaken by it, which is more extensive than is commonly found in the case of plants of this size. The voltage of a part of the output is stepped up to 60,000 volts through three 600-kw transformers, the energy being sent over a 30-mile line northward, reaching three or four neighboring communities. The plant already serves 6400 customers and for its size carries an unusually heavy motor load, rising to nearly 5000 hp of motors. Altogether the Wichita plant is an excellent example of thoroughly sound recent practice applied in the organization of a plant of moderate size with a rather diversified business and many inviting opportunities for expansion.

SELECTION OF A WATERWHEEL UNIT.

Among the papers read at the recent Pacific Coast meeting of the American Institute of Electrical Engineers was one by Mr. O. B. Coldwell on the selection of a waterwheel unit. This is a subject of great practical importance to engineers in general, and particularly to electrical engineers, who are likely to be more familiar with the electrical details than with the hydraulic details of a combined hydroelectric plant. It has occasionally happened that in such a plant, combining waterwheels and electric generators, the speeds and sizes of the generators were decided on and contracted for without proper attention being given to the hydraulic conditions and the best arrangement of waterwheels, with the result that the output and efficiency of the finally constructed plant failed to come up to expectations. The lack of cohesion between expectation and fulfilment has been most frequently noticeable in regard to maintenance of water-power during the low-water season of the year. The designing engineer may have first visited the hydraulic site at a time of flood and may have lent too widely opened an ear to the statements of honest but untrained observers, living permanently on the land, as to the conditions of minimum flow. The result has been in many cases an undue expenditure of capital upon insufficient water reserve. Disappointment in the performance of hydroelectric plants has led occasionally to disputes and mutual recriminations between waterwheel manufacturers and generator manufacturers, each putting the principal share of the blame on the other. It seems likely that as both classes of manufacturers gain experience with the performance of units formed by their combined machines this want of confidence will become a thing of the past. In reality a good electric generator, separately tested for its losses, is as convenient and satisfactory a means of testing the efficiency of a turbine by which it is driven as can well be devised.

REPORT OF THE BRITISH NATIONAL PHYSICAL LABORATORY.

The report of the National Physical Laboratory of Great Britain for the year 1911 contains much noteworthy material. In the first place, it is self-evident on consideration that any national laboratory in which first-class scientific work is carried on and recorded is necessarily an international laboratory in that science is world-wide and international. The work done at one national laboratory, say in Great Britain, differs from that done at another, say in France, when viewed broadly, only in the fact that it is recorded and published in English in one case and in French in the other. Moreover, all the primary work on metrology, such as the intercomparison of the concrete units of length, mass, time, current-strength, resistance, voltage, candle-power, etc., is essentially international work calling for collaboration with national laboratories in other countries. It may even be said that as soon as any work carried on in a national physical laboratory becomes promoted to the highest plane it becomes thereby internationalized, or that only the work which has not yet received its final recognition can remain in the strictly national class. Consequently, all such national laboratories are of the greatest mutual importance in all countries internationally, besides their great local and national importance in developing the knowledge, applied science, manufactures, engineering and industries of the country in which each exists. The British report indicates how manifold are the interests embraced by physics. The official list of tests made during the year covers electrical measurements, electrotechnics, photometry, thermometry, optics, metrology, taximeter testing, engineering, the national tank for ship model testing and the observatory department. A large amount of miscellaneous testing and research is also included.

It is interesting to note that in the measurement of inductances such precision is now reached as brings into prominence the temperature-coefficient of mutual inductance, due to changes in linear dimensions of coils with temperature. It is pointed out that when two coils, one nested within the other, are made of wire from the same metal

their mutual inductance always increases slightly with temperature; but that by making the outer coil of aluminum wire and the inner coil of copper wire it is possible to obtain a zero temperature-coefficient of mutual inductance between them. Some absolute measurements of resistance are summarized, which go to show that the international ohm is bigger than the true ohm as defined in the c. g. s. system by about one-fortieth part of 1 per cent. This is only a preliminary report on this question. It has long been believed that an error of such magnitude existed in the international ohm, although this is perhaps the first official announcement of its approximate amount. It is evident that if the discrepancy is no worse than that reported, the electrical engineer's measurements are not likely to be seriously affected. A novel term makes its appearance in the report in relation to experimental work on the international ampere. This term is "electrostenolysis." The term is not clearly defined, but it is evident that the thing itself is a grievance to the electrochemist engaged in accurate electrolytic measurements of electric current strengths.

TESTS OF INSULATING MATERIALS.

Electrical engineering employs both conductors and insulators. The progress of electrical engineering, especially in the departments of design and construction, depends upon the development of the properties of good conductors on the one hand, and on the development of the properties of good insulators on the other. It happens that up to the present time the best conducting properties have always been found associated with the metals, particularly with copper, silver, aluminum and iron, copper being by far the best under commercial conditions for use in electrical machinery. The highest conductivity has thus far always been found associated with the highest degree of chemical purity in these metals. Consequently, there is in sight little room for improvement in the conducting properties of electric conductors. The mechanical properties of conductors also leave little to be desired. Metals of good conductivity are ductile, easily worked by tools, and are good conductors of heat. Soft copper is somewhat lacking in mechanical strength, although not objectionably weak in ordinary dynamo construction, where its imposed tensile stresses are very moderate. In the case of aerial wires, it is necessary to use hard-drawn copper in order to obtain a fair degree of mechanical strength, although at a loss of some 2 per cent in electric conductivity.

The field of electric insulators is, however, both broader and more complex. There are all too few available good insulating substances which are at the same time mechanically strong, permanent and workable under tools. Glass, for example, is a typically good electric insulator, but it is so brittle that it cannot be made to withstand the mechanical and thermal stresses of elements in rotating machinery. So many good insulators are mechanically brittle that it would seem at first sight as though insulation was a property associated with brittleness in solids. It is, however, unsafe to make generalizations in the present imperfect state of our knowledge concerning the electrical properties of matter. It is, however, generally supposed that the property of electric conduction is due to the facility with which electrically charged corpuscles, or electrons, can be made to pass to and fro between adjacent atoms or molecules. The opposite property of electric insulation thus assumes a difficulty in passing such electrons between adjacent atoms; or, as it might be called, a sub-atomic rigidity. It is therefore not surprising that, according to such a hypothesis, the sub-atomic rigidity is often associated in solids with molar rigidity, or brittleness.

Not only are electric insulators mechanically weak, taken as a class, but they are also very poor thermal conductors. The same infacility for transferring electric charges from atom to atom seems to go with a notable incapacity for transferring jostle-energy, or heat, from atom to atom; so that although the electric and thermal conducting processes seem to be very different, yet the classification of substances in their order of electric conductivity is very similar to their classification in order of thermal conductivity. This is, of course, a disadvantage from the standpoint of the dynamo designer, who seeks to insulate his heated active copper conductors with substances that carry away the heat with but little difference of thermal potential, or temperature. Moreover, a good insulator should, from the dynamo designer's standpoint, be strong, permanent, non-oxidizable, fireproof, unbrittle or elastic, impermeable to moisture, easy to work, unaltered by changes of temperature, and cheap. We do not yet know just on what conditions within a substance the insulating quality depends. It is certainly influenced by physical as well as chemical conditions, because changes of temperature have marked influence on the insulating properties of non-conducting materials.

The *Elektrotechnische Zeitschrift*, as noted in our *Digest*, has recently published a report, by Dr. H. Passavant, on researches made officially in Germany on the properties of insulating substances, from the mechanical, thermal, chemical and electrical standpoints. On each substance the tests were made on test-pieces of specified dimensions, and the means of three such tests were tabulated in a certain graphic schedule card which shows at a glance of the practised eye the relative merits of the substance along each of the lines of recorded test. There can be no doubt of the value and importance of such systematic testing schedules. The results of such tests are significant in regard to the improvements which may be arrived at in the manufacture and preparation of insulating materials as used in industry. The only question is as to the degree of uniformity which can be insured in the substances themselves. For example, slate is a fairly cheap substance that possesses many good qualities in addition to non-conduction, and samples of slate, tested according to the schedule, would no doubt give a satisfactory index of its relative merits for any specified purpose in design; but we know that slate, like many other minerals, is often unhomogeneous, and an unsuspected flaw in a slate slab has often marred an otherwise good switchboard panel. Consequently, the scheduled tests of an insulating substance can only be taken as indicating how it can behave if it is good, and not necessarily how it will operate when subjected to actual service conditions.

ANNUAL MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The annual meeting of the American Institute of Electrical Engineers was held on May 21 in the Engineering Societies Building, New York, President Dunn presiding. The first business was the consideration of the annual report of the board of directors, which had been printed and distributed in advance and was therefore very briefly abstracted by Secretary F. L. Hutchinson. It is gratifying to note that the income for the year left a surplus of about $5,600 over expenditures. The report was formally adopted and placed on file.

The next formal business was the announcement of the result of the election of officers for the coming year, who are as follows: President, Mr. Ralph D. Mershon; vice-presidents, Messrs. William S. Murray, Arthur W. Berresford and S. D. Sprong; managers, Messrs. Comfort A. Adams, William B. Jackson, William McClellan and J. Franklin Stevens; treasurer, Mr. George A. Hamilton, and secretary, Mr. F. L. Hutchinson. In the midst of applause President Dunn formally declared these officers elected.

The next announcement was the result of the ballot on the constitutional amendments relating to the election of the secretary and changes in the grades of membership. Out of 3314 valid ballots cast in the vote on the amendment relating to the office of secretary, 3034 were in favor of and 280 against the amendment. President Dunn announced that the constitutional requirements for the passage of an amendment had been complied with and formally declared the constitution amended. The vote on the amendment relating to an additional grade of membership consisted of 3372 valid ballots, of which 2800 were for and 572 against the proposition. The president again declared that the constitutional requirements had been met and declared the amendment in force, amid enthusiastic applause.

The feature of the evening was the presentation of a bronze bust of Joseph Henry to the Associazione Elettrotecnica Italiana. The formal presentation on behalf of the Institute was made by President Dunn, and the bust was received for the Italian society by its specially appointed delegate, Mr. Philip Torchio, also a member of the Institute. Mr. Torchio formally acknowledged the gift by reading a letter from Secretary General Parvopassu of the Italian society to Secretary Hutchinson of the Institute, and a cablegram from President Lori of the Italian society to President Dunn, concluding with a brief address in which he referred to the gift of the bust of Ferraris to the Institute from the Italian society.

On this occasion Dr. Charles A. Doremus, in behalf of Dr. Henry E. Waite, of New York, presented the Institute with the astatic galvanometer which was removed from Henry's laboratory at Washington and purchased by William Green, of the Smithsonian Institution, who in turn gave it to Dr. Waite. Dr. Doremus also presented the Institute with one of the famous coils made by Prof. Henry and used in his experiments on self-induction. This same coil was used for many years by Prof. R. Ogden Doremus in presenting Henry's demonstrations to the students at the College of the City of New York. The gifts to the Institute from Dr. Waite and the family of Prof. Doremus were appropriately acknowledged by President Dunn.

A part of the formal program was a paper by Mr. John C. Barclay on "Henry as the Inventor of the Telegraph," but owing to Mr. Barclay's unavoidable absence his manuscript was read by title, and President Dunn then introduced Dr. M. I. Pupin, who delivered a splendid address on "The Debt We Owe to Henry as a Scientist." A brief abstract of this address will be found elsewhere. At the close of these exercises the meeting adjourned and was followed by the usual smoker.

BUST OF JOSEPH HENRY PRESENTED TO THE ASSOCIAZIONE ELETTROTECNICA ITALIANA.

The cordial and friendly relations existing between the American Institute of Electrical Engineers and the Associazione Elettrotecnica Italiana, already attested by the gift to the Institute of the bust of Galileo Ferraris from the Italian society, has just received further accentuation by the presentation of a bronze bust of Joseph Henry to the Italian society from the Institute. The formal presentation was made on May 21 at the annual meeting of the American Institute of Electrical Engineers, on which occasion the Italian society had appointed a committee of resident New York members, with Mr. Philip Torchio as chairman, to receive the gift on behalf of their society. President Dunn of the Institute formally presented the bust to the Italian society at the close of a sympathetic address, in which he sketched the close bonds of friendship between the Institute and the Italian society.

Mr. Philip Torchio responded on behalf of the Associazione Elettrotecnica Italiana with a brief address of thanks. The remainder of the program consisted of an address by Dr. M. I. Pupin on "The Debt We Owe to Henry as a Scientist" and a short paper by Mr. John C. Barclay, formerly chief engineer of the Western Union Telegraph Company, on "Henry as the Inventor of the Telegraph." In the unavoidable absence of Mr. Barclay his paper was read by title and will appear in the Institute *Proceedings*.

The feature of the evening was the inspiring address delivered by Dr. Pupin on Henry as a scientist. Dr. Pupin sketched the development of electrical science from the period of Gray's discovery of electrical conduction, in 1729, down through the discoveries of Franklin, Galvani and Volta, to the opening period of the nineteenth century, then dwelling upon the researches of Oersted and Ampère. At this time three great men, Volta, Oersted and Ampère, accomplished more in the space of twenty years than had been accomplished before in the science of electricity in 2500 years. Their work marked the beginning of the great period of electrical discovery, in which Joseph Henry and Michael Faraday were soon to join. The independent discovery of the principle of electromagnetic induction by Faraday and Henry was the beginning of the wonderful modern era of electrical science.

Following the discoveries of Oersted and Ampère came the work of Arago, who showed that electricity in motion is capable of magnetizing a steel needle, and then came Sturgeon, who invented the electromagnet in 1823. At this time Joseph Henry was but twenty-four years of age and engaged as a private tutor in Albany, N. Y., spending his leisure time in studying mathematics and analytical mechanics. Becoming interested in electrical science, he rose in less than five years to be the only authority at that time on electromagnets. His studies in this direction led to the discovery in 1831 of electromagnetic induction. Henry's character was one of extreme modesty, and he shrank from ever advancing himself as a rival to the great Faraday in the discovery of the law of induction, and consistently he refused to claim as his own the invention of the electromagnetic telegraph. In fact, he referred to his telegraph as Mr. Barlow's project and never laid any claim to it. Moreover, in 1856, he recommended that an extension of the Morse patent be granted to Morse.

Dr. Pupin referred to the proposal originally advanced by Prof. F. B. Crocker that the unit of self-induction be named after Henry. At the International Congress at Chicago in 1893 this proposal was adopted, and it is impressive to recall that the motion for adoption was made by Ayrton and seconded by Mascart, the presiding officer being none other than the famous Helmholtz. Dr. Pupin referred to another electrical phenomenon which was dis-

covered by Henry and described by him before the Philosophical Society in 1842, namely, the oscillatory nature of the discharge of a Leyden jar. Henry also demonstrated the magnetic effect of such oscillations, and a study of this problem absorbed him for a considerable period. In closing, the speaker referred to Henry's great service to his country in organizing the Smithsonian Institution along the lines which were intended by its founder, Smithson, when there was great danger that politicians and intriguers at Washington would seize the foundation for purely selfish purposes.

At the close of this earnest and interesting address on the life work of Joseph Henry, President Dunn conveyed to the speaker the thanks of the Institute for the inspiration which he brought to this notable occasion and for so vividly portraying the true scientific spirit. President Dunn then concluded by extending the thanks of the Institute to the well-known sculptor who executed the bust, Mr. Herbert Adams, who attended as the Institute's guest.

GOVERNMENT AND THE ALUMINUM INTEREST.

On May 16 the government filed a petition in equity in the federal court at Pittsburgh, Pa., against the Aluminum Company of America, under an understanding with the company that a decree would be entered enjoining it in certain of its contractual relations, as was forecast in the *Electrical World*, March 30, 1912, page 670. The petition alleges that the company controls over 90 per cent of the known deposits of bauxite in the United States and Canada; that it produces virtually 80 per cent and consumes nearly 100 per cent of the alumina used in the manufacture of aluminum, and that it manufactures practically 100 per cent of the crude and semi-finished aluminum produced in the United States and Canada.

It is also charged that the company controls and sells over 70 per cent of the aluminum cooking utensils in this country, over 50 per cent of the aluminum castings and over 70 per cent of all aluminum goods of general character made and sold in the United States.

The petition alleges further that the company entered into agreements with certain domestic and foreign concerns binding them not to engage in the manufacture of aluminum or the sale of the product or its base to any but the defendant, and also charges that the latter so carried on its affairs that competitors were at its mercy for their supply of raw materials. It is further stated that the Aluminum Company of America, known originally as the Pittsburgh Reduction Company, was incorporated in 1888 with a capitalization of $20,000, which was increased in 1899 to $1,000,000; that $720,000 of this amount was estimated as the value of certain patents issued to Mr. Charles M. Hall for a process for the manufacture of aluminum, and that the company has grown rapidly in size and strength until it and its subsidiary corporations now own assets estimated at $27,000,000. A profit of 17 per cent on this investment in 1910 is admitted by the defendant, according to the petition, which states that the prices now charged for aluminum are not in proportion to cost of manufacture.

It is not claimed by the government that it was unlawful for the defendant to exclude all others from the manufacture of aluminum prior to expiration of its patents in 1909, but it is held that its operation since then has been unlawful. The contention is also made that the possession of a practical monopoly of raw material must be considered in determining whether the company operates in restraint of trade. An injunction is asked by the government to prevent the continuauce or repetition of any of the alleged unlawful practices and contracts and to prohibit the company from purchasing or combining with any independent concerns in the industry. This decree became effective upon the filing of the petition.

WESTINGHOUSE ANNUAL REPORT.

The report of the operations of the Westinghouse Electric & Manufacturing Company and of its subsidiary companies for the fiscal year ended March 31, 1912, shows that the sales billed last year were $3,922,866 less than those billed in the preceding year, when the business of the company was the largest in its history. The total sales for the year were $34,196,446, as compared with $38,119,312. In his remarks to the stockholders, Mr. Guy E. Tripp, chairman of the board of directors, attributes this decrease in part to a reduction in output, and, to a larger extent, to lower prices obtained for the products.

A comparative statement of operations of the Westinghouse Electric & Manufacturing Company and its subsidiary manufacturing companies in the United States for the past two years is shown herewith. These subsidiaries are the Westinghouse Lamp Company, operating plants in Bloomfield, N. J., and New York City; the Bryant Electric Company and the Perkins Electric Switch Manufacturing Company, operating plants at Bridgeport, Conn., and the R. D. Nuttall Company, operating a plant at Pittsburgh, Penn.

TABLE I.—COMPARISON OF EARNINGS.

	Year Ended March 31.		
	1912.	1911.	Decrease.
Gross earnings—sales billed	$34,196,446	$38,119,312	$3,922,866
Cost of sales, including all selling, administration and general expenses	30,604,850	32,510,547	1,905,697
Net manufacturing profits	$3,591,596	$5,608,765	2,017,169
Other income	1,160,442	1,515,531	355,089
Total net income	$4,752,038	$7,124,296	$2,372,258
Deductions from income, for inventory adjustments, extraordinary items, etc.	708,917	657,704	*51,213
Balance for charges	$4,043,121	$6,466,592	$2,423,471
Interest charges	1,599,028	1,585,487	*13,541
Surplus for the year	$2,444,093	$4,881,105	$2,437,012
Previous surplus	5,964,225	5,668,948	*295,277
Profit and loss credits	126,628	680,309	553,681
Total surplus	$8,534,946	$11,230,362	$2,695,416
Deductions:			
Preferred dividends	$279,909	$279,909	.....
Accumulated preferred dividends	.....	349,886	$349,886
Common dividends	352,117	.....	*352,117
Depreciation of investments	1,050,285	3,591,123	2,540,838
Reserved for accounts receivable	.....	589,774	589,774
Miscellaneous	203,671	455,440	251,769
Total deductions	$1,885,982	$5,266,136	$3,380,150
Profit and loss surplus	6,648,964	5,964,226	*684,738

*Increase.

The value of unfilled orders as of March 31, 1912, was $8,137,961, which compares with $7,616,058, as of March 31, 1911. During the month of April last the value of orders booked exceeded that of any month during the year ended March 31, 1912, with the result that the value of unfilled orders as of April 30, 1912, was $9,218,302.

The report states that the suit brought against the Westinghouse and other companies by the United States with respect to the incandescent lamp business, to which reference was made in the preceding report, was terminated during the year by the entry of a decree which has not seriously affected the conduct of the Westinghouse lamp business.

The gross earnings, net manufacturing profits and surplus for the past six years ending March 31 compare as shown in Table II.

Deductions from the total surplus included 7 per cent preferred dividends, amounting to $279,909, and a dividend of 1 per cent, or $352,117, on the common stock, which was

declared March 27, 1912. These deductions left a balance of $7,699,249, against which depreciations of investment were written off as follows: Stock, Westinghouse Electric Company, Ltd., $250,000; debentures, Société Électrique Westinghouse de Russie, $243,243; and bonds, Lackawanna & Wyoming Rapid Transit Company, $557,042, making a total of $1,050,285, and leaving a surplus as of March 31, 1912, of $6,648,964. The balance sheet as of that date shows total assets of $82,620,653, of which the principal

TABLE II.—COMPARISON OF EARNINGS 1907-1912.

Year.	Gross Earnings.	Net Manufacturing Profit.	Surplus for the Year.
1912	$34,196,446	$3,591,596	$2,444,093
1911	38,119,312	5,608,765	4,881,105
1910	29,248,682	3,552,978	3,060,664
1909	20,606,592	650,784	*1,405,015
1908	32,844,829	2,543,682	950,835
1907	33,026,240	*4,179,575	2,773,174

*Deficit.

items are as follows: Property and plant, $19,195,188; investments, $23,384,515; current assets, $19,848,706; patents, charters and franchises, $6,097,742.

Discussing the assets, the report states that the property and plant item as above represents an increase of $1,503,042 over that for the previous year. This increase is chiefly due, it states, to completion of the extensions of the buildings on the additional ground purchased for the Newark (N. J.) plant that were in progress at the close of last year, to which reference was made in the previous report. Other items contributing to the increase in this item were the purchase of a new plant at Pittsburgh by the R. D. Nuttall Company, which had previously occupied leased premises not well adapted to its manufacturing requirements, and the erection of a new four-story and basement building and other improvements at the East Pittsburgh works.

The purchase at Newark, N. J., and that by the Nuttall company at Pittsburgh include considerable real estate not yet occupied by buildings, erection of which later on will still further increase the manufacturing facilities of the Westinghouse company. The buildings already erected have resulted in a considerable increase in the output and efficiency of each of these plants. The plans mentioned in the previous report for the erection of foundry and pattern buildings at Trafford City, Pa., have not been carried out, but it is possible that the erection of these buildings will be started during the current year. The lease of the properties on which the Westinghouse company operates an iron foundry at Pittsburgh has been extended.

The aggregate book value of investments as of March 31, 1912, shows a decrease of $650,120 as compared with the book value as of March 31, 1911. The report states that the only important cash investments made during the past year were $143,041 bonds of the Westinghouse Electric & Manufacturing Company, which were purchased in anticipation of sinking fund requirements due Dec. 31, 1912, and $481,335 debentures of the Societa Italiana Westinghouse which were received in payment for cash advances made partly during the year ended March 31, 1911, and to which reference was made in the report for that year.

The charges to patent account during the year aggregated less than $25,000. All other expenses for patents, licenses, development and experimental work were charged to expenses and were included in the cost of sales. The statement of liabilities shows capital stock of $40,698,987, of which the preferred stock amounts to $3,998,700 and common stock to $36,700,287. Of this, $35,193,287 is in the hands of the public and $1,507,000 is in the treasury. The funded debt as of March 31, 1912, was $22,334,000, and current liabilities were $3,047,874.

Very little space is given in the report to the affairs of the foreign Westinghouse companies in which the company has the largest investments. These companies were described at considerable length in the previous report. In his remarks to the stockholders Mr. Tripp states that there were no unusual developments during the past year in connection with the affairs of these foreign companies. The British, French and Canadian Westinghouse companies all improved in net profit during the year ended Dec. 31, 1911, as compared with the previous year, and some improvement was also shown by the Russian company. Owing to the war between Italy and Turkey, the Italian government has delayed the further electrification of the state railways, and as no orders were received for electric locomotives by the Italian company during the year ended Dec. 31, 1911, its business showed some falling off.

NATIONAL FIRE PROTECTION ASSOCIATION.

The sixteenth annual meeting of the National Fire Protection Association was held in Chicago on May 14 to 16, with an attendance of about 300. The association conducts an educational campaign against fire waste from an office in Boston, where Mr. Franklin H. Wentworth is the salaried secretary and treasurer. Among the active members are the American Institute of Electrical Engineers, American Electric Railway Association, National Electrical Supply Jobbers' Association, National Association of Electrical Inspectors, National Electrical Contractors' Association and National Electric Light Association. Most of the active members, however, are representatives of insurance interests. An effort was made to broaden the scope of the association by admitting individuals, firms and corporations to active membership, instead of restricting them to associate membership with no vote, but action was deferred for one year.

Mr. W. H. Merrill, manager of the Underwriters' Laboratories, Chicago, president of the association, presided at the convention. Reports of the committees covered a wide range of subjects, only two being of direct electrical interest. The first of these was presented by Mr. C. H. Patton, of Cleveland, and was a progress report on "Electric Railway, Light and Power Properties." Since the last convention recommendations have been received for modifications in existing rules for carhouse construction and protection. There is a conflict between the standards of the National Fire Protection Association and those of the Central Traction and Lighting Bureau and the American Electric Railway Association. The committee reported that it does not appear advisable to attempt to modify the N. F. P. A. standards until such time as the three associations can get together and agree on one national standard. The committee was continued in the hope that a joint conference may be arranged.

Mr. F. E. Cabot, of Boston, presented a brief report from the electrical committee, which is concerned with the safe installation of electrical equipment to prevent damage from fire. A new rule has been adopted in relation to moving-picture machines, allowing such machines to be driven by a motor. There is a slight change in the rule relating to the manner of installing signaling wires entering buildings, and there has also been some change in the marking of switches to enable manufacturers to put on the market the kind of product they find desirable. The committee presented a resolution thanking Mr. C. M. Goddard, of Boston, for his very efficient service for a long term of years as secretary of the Underwriters' National Electric Association. Mr. Cabot, on behalf of the association, presented to Mr. Goddard a three-piece silver service.

Before adjournment Mr. Powell Evans, of Philadelphia, made a plea for more systematic work to prevent fire waste. The association is doing valuable work along educational lines, but Mr. Evans thinks that there should be an enlargement of its activities by direct co-operation with states and municipalities in legislative matters. He advocates a broad program of this sort and his suggestions were referred to the executive committee. The question of recommending the exclusive use of motor-driven fire engines was also referred to the executive committee.

Officers were elected as follows: President, Mr. H. L. Phillips, Hartford, Conn.; vice-president, Mr. George M. Robertson, San Francisco; secretary and treasurer, Mr. Franklin H. Wentworth, Boston; chairman of executive committee, Mr. F. J. T. Stewart, New York. After Mr. Merrill had retired from the chair Mr. Goddard took the floor, and at the conclusion of a felicitous speech presented to Mr. Merrill a pair of silver candlesticks. After adjournment a visit of inspection was made to the Underwriters' Laboratories, where some interesting tests were made. The executive committee will choose the next place of meeting.

SCHENECTADY MEETING OF THE A. I. E. E.

The two hundred and seventy-third regular meeting of the American Institute of Electrical Engineers was held at Schenectady, N. Y., on May 17, in the convention hall of the Mohawk Golf Club, under the auspices of the Schenectady Section. The opening session was called to order at 9 a. m. by President Dunn, with about 300 members and guests in attendance, and Mayor George R. Lunn of Schenectady delivered a cordial address of welcome, which was appropriately responded to by Dr. C. P. Steinmetz. A very interesting technical program of ten papers, as announced previously, was then taken up. Abstracts of the papers and discussions appear below. At the close of the morning session Chairman E. B. Merriam of the local section called attention to the afternoon program, which consisted of inspection trips to the Schenectady works of both the General Electric Company and the American Locomotive Company and also to the Schenectady Water Works, the routes being arranged so that these visits could be combined in several ways, as desired. For those who preferred, however, the courtesies of the club were extended for tennis and golfing. An informal buffet luncheon was served to all present.

At 6 p. m. a "Dutch" dinner was served at the club house, the attendance being even larger than expected. After the courses had been served Chairman Merriam presided as toastmaster and called on several members for informal speeches. Among those who spoke were Past-president Scott, Mr. P. M. Lincoln, Mr. W. B. Potter, Prof. J. P. Jackson and President Dunn. Following these remarks, some of which were semi-humorous and others in a serious vein, those present adjourned to the convention hall and attended the evening technical session. At the close of the latter there was an informal smoker and social gathering, marking the close of a very successful and profitable meeting. There was an unexpectedly large attendance, the total registration numbering 350 members and guests. The entire program, both technical and social, was thoroughly enjoyed.

MORNING SESSION.

COMPRESSION CHAMBER LIGHTNING ARRESTER AND THE PROTECTION OF DISTRIBUTION CIRCUITS.

The opening paper was presented by Messrs. E. E. F. Creighton and F. R. Shavor on the above topic, describing a new type of inclosed multigap arrester with antennas and a series resistor, designed particularly for the protection of 2300-volt pole-type transformers. The arrester is self-contained in a porcelain tube, which incloses the resistor and below it a series of gaps between metal units constructed of special alloy, the tube being hermetically sealed at top and bottom. The average value of resistance employed is 23 ohms, which gives a discharge rate, assuming a 15,000-volt lightning stroke at the arrester terminals, equal to 650 amp. The antennas increase the grounded electrostatic capacity of each metal electrode in the gap series, producing uniformity of the spark potential and diminishing its magnitude exactly one-half as compared with the spark potential without antennas. The increased chamber pressure, due to gas expansion attending discharge, tends to extinguish the arc. The most desirable value of spark potential is about 0.7 of the value at which the transformer insulation is tested; this value is apparently safe for the transformer and at the same time protects against internal surges which reach a dangerously high potential. In the case of very severe direct strokes the heat suddenly developed by the resistor will shatter the porcelain tube and the arrester will clear itself automatically from the line.

HUMAN ACCURACY: MULTI-RECORDER FOR LIGHTNING PHENOMENA AND SWITCHING.

The paper on this subject presented by Messrs. E. E. F. Creighton, H. E. Nichols and P. E. Hosegood first took up at some length the psychological aspect of human accuracy in observing rapidly occurring events, particularly under the stress of excitement or anxiety, and pointed out the great extent to which even trained observers will vary in their descriptions of the same rapidly occurring phenomenon. A number of examples of this were cited in the field of electrical phenomena and the advantages of having an automatic recording device were pointed out. The authors have developed such a device for keeping a record of electrical switching operations and the operation of lightning arresters, which they term a multi-recorder. Any phenomenon may be recorded which in some way can be made to close an electrical contact or produce a marked change in the properties of an electrical circuit. The principal parts of these multi-recorders comprise a master clock, time-wheels for printing, record-wheels or pencils, the printing mechanism, the paper-driving mechanism and the outside contacts which actuate the mechanism in response to the occurrence of phenomena which it is desired to record.

STUDIES OF PROTECTION AND PROTECTIVE APPARATUS FOR ELECTRIC RAILWAYS.

In a comprehensive paper Messrs. E. E. F. Creighton, F. R. Shavor and R. P. Clark discussed protective apparatus for electric railways and the application of aluminum arresters to this class of work. The authors first investigated the relation of car wiring to protection in general, and found it imperative to avoid placing any wire that carries lightning current near or parallel to any of the wiring in which damage might occur as the result of induced charges. The experiences in applying aluminum arresters to the system of the Denver (Col.) City Tramway Company, where lightning disturbances of the utmost severity were experienced, were described in detail. Discussing the choice of the proper type of arrester for a given situation, the authors point out that the direct-current aluminum arrester, directly connected without gaps or resistors, gives the most efficient protection known and is especially applicable where the total elimination of risks is very important, as in electric locomotives. Part of the paper was devoted to a description of the redesign of the early magnetic blowout type of arrester, illustrated by numerous oscillograms which served an important part in the work.

PROPAGATION OF IMPULSES OVER A TRANSMISSION LINE.

In a paper on this subject by Messrs. J. H. Cunningham and C. M. Davis, the results were given of an experimental

study of an artificial transmission line having an equivalent length of 128 miles. Momentary impulses were impressed upon this line by means of a transformer whose secondary was connected to the line circuit and whose primary was connected to a direct-current source through a drop switch. The details of this artificial transmission line, including its design, construction and performance tests, were given in an Institute paper presented in January, 1911. By means of oscillograms the authors investigated the agreement between observed impulses and those calculated from the line constants. Although the square of the total line resistance was less than the quotient of four times the line inductance divided by the line capacity, which is the condition for oscillatory charging and discharging in circuits containing lumped resistance, inductance and capacity, the transient impulses observed in this line were always of non-oscillatory character.

SOME MECHANICAL CONSIDERATIONS OF TRANSMISSION SYSTEMS.

The paper by Mr. T. A. Worcester on mechanical considerations in transmission systems presented a general discussion of the more prominent features in mechanical design, illustrated by several examples of the most recent practice. The author presented a curve showing the relation between the cost of a transmission line and the length of the spans, which exhibits a minimum cost for spans of 700 ft. The standard span loading, in addition to the dead load, is an ice deposit ½ in. thick, in conjunction with a wind pressure of 8 lb. per square foot, at a temperature of 0 deg. Fahr. For crossings at rivers, highways or railroads the ice load should be increased to ¾ in. and the wind to 11 lb. The general effect of span failures on the tower stresses was discussed at some length, with particular relation to the assumption made by the designer in reference to the number of conductors which may fail simultaneously. Rigid and flexible types of towers were discussed, and the advantages of the latter type in cheapening the cost of construction were pointed out.

ELECTRICAL CHARACTERISTICS OF SUSPENSION INSULATORS.

The paper by Mr. F. W. Peek, Jr., presented new data on the electrical characteristics of suspension insulators, with particular attention to the string efficiency. The investigation covered tests on various sizes of insulators of different manufacture, commencing with a single unit and increasing the number, one at a time. Comparisons were made between the tested characteristics and the calculated characteristics, the mathematical analysis underlying the calculations being presented in the paper. The author submitted a series of eight conclusions, which are summarized in what follows. While a single insulator-unit may show excellent individual characteristics, it may be unfit for use in series with other units on account of certain inherent relations between the mutual capacity and the ground capacity; the best insulator is not always indicated by an arc-over voltage test of a series of units, but this test should be supplemented by a study of corona formation in the individual units and a comparison of the arc-over and theoretical efficiency curves; when the mutual capacity is small in comparison with the ground capacity, it is useless to increase the number of units beyond a certain point; insulation for extremely high voltages will probably be obtained by short strings properly designed and spaced, and possibly the units may be graded; a high string efficiency should always be sought; the arc-over voltage will generally decrease as the frequency increases, owing to leakage, and it will also decrease with rise of temperature and fall of barometer; the wet arc-over voltage will vary to a great extent with the nature of the spray and with the temperature and resistance of the rain, and after reaching a certain critical string length the wet arc-over voltage may exceed the dry arc-over voltage; in making insulator arc-over tests one side of the transformer should be grounded, and precautions should be taken to eliminate resonance.

Discussion.

Mr. E. M. Hewlett opened the discussion and pointed out that since the development of the suspension insulator was first announced at the Niagara Falls meeting of the Institution in 1907 operating voltages have risen from 110,000 volts to 140,000 volts and the economic range of transmission has been substantially doubled. He announced that the reports of operation from the 140,000-volt system of the Au Sable Electric Company, covering now a period of several months, are very satisfactory. It is also worth noting that the disk type of insulator is sometimes cheaper for low-voltage work than the pin type.

Mr. P. M. Lincoln, referring to Mr. Peek's paper, questioned whether the reasons for obtaining a higher arc-over test when the insulator string is wet had been correctly analyzed. He attributed this result to changes in the mutual capacity from unit to unit when they become wet, and suggested grading the units in such a manner as to give the line unit the maximum mutual capacity, with the object of obtaining a more uniform voltage gradient.

Continuing the discussion, Mr. William McClellan pointed out the mechanical advantages of the overhead ground wire, and stated that one of the important advantages of the suspension type of insulator is its flexibility, which in the case of a broken span adds slack to the adjacent spans and thus reduces the stresses. He cited an instance in which a falling tree carried down five conductors in a span, leaving only one remaining besides the ground wire, but no damage to the towers resulted; in this case six insulator units were employed in each suspension, having a total length of 4½ ft., and the ground wire was a 5/16-in. Siemens-Martin strand.

Mr. C. E. Magnusson read a communication before the meeting giving the results of similar tests on suspension insulators carried on at McGill University, which check very well with the results obtained by Mr. Peek. However, they employed at McGill a somewhat more elaborate theory of mutual and grounded capacities in the string. The theoretical calculations were carried out for strings up to six units, at which point the computations became rather complicated.

Dr. C. P. Steinmetz discussed the theory of potential distribution in multi-gap arresters and strings of suspension insulators, pointing out that in the first case it is desirable to obtain the maximum gradient at the first gap, whereas in the second case it is desirable to have a perfectly uniform gradient over the whole string. While the series and shunt capacities appear to be independent of the frequency, this is probably untrue when the frequency becomes very great, for then the unit next to the line tends to puncture. In some cases, however, the brush discharge or corona relieves the steep potential gradient and produces a more even distribution. It is not yet known, however, whether corona occurs instantaneously at extremely high frequencies. If, in fact, there is any time lag under these conditions, the resulting effect is that of a very sudden stroke, and hence one cannot judge the potential distribution in such a transient state from laboratory tests made at lower frequencies where the occurrence of corona is not in doubt.

Closing the discussion on protective apparatus, Mr. R. P. Clark explained that the aluminum arrester had to overcome much early prejudice. When connected directly to the line, without intervening gaps or resistors, it has a comparatively short life. The addition of a gap in series with resistance lengthens the life and diminishes the cost of maintenance, without materially impairing the efficiency for car service, unless the lightning disturbances are excessively severe. Mr. T. A. Worcester, in closing the discussion on his paper, said that he did not regard the advantages of flexible suspension as important, because the

most serious stresses arise, in his opinion, from the sudden jerk thrown on the cross-arms by the spans adjacent to the break. Mr. Peek closed by pointing out that the leakage current over a string of wet insulators is large in comparison with the capacity charging current when the string is dry, which accounts for a more even distribution of potential in the wet string and consequently better performance.

FREQUENCY.

The paper by Mr. D. B. Rushmore on the relation of frequency to alternating-current phenomena and machinery opened with the statement that the choice of frequency for commercial lighting and power systems is far from settled. The paper itself was an excellent symposium on frequency, setting forth its relation to the art under the following topics: Generators, transformers, transmission lines, lightning, induction motors, synchronous motors, frequency changers, railroad work, switching phenomena and illumination, and concluding with a table of frequencies used in some forty-five installations in this country. No recommendations were advanced, however, and the paper was evidently intended to provoke general discussion.

Discussion.

Prof. Samuel Sheldon opened the discussion, pointing out that the cost-capacity curves given in the paper were seriously defective in the respect of lacking all designation of the co-ordinate axes or the origin of axes, and also lacking numerical magnitudes on both ordinates (cost) and abscissas (capacity rating). Mr. J. J. Frank discussed the relation of frequency to transformer design. At 60 cycles the core loss is 2.7 times as large as it is at 25 cycles, but at the latter frequency the core area is 2.4 times as large and the weight is greater. At 25 cycles the efficiencies are from 0.2 per cent to 0.8 per cent lower than at 60 cycles and the costs are greater. Mr. B. G. Lamme reviewed the early history of the art leading to the selection of the frequencies now standard. The pressing need, in his opinion, is the adoption of frequencies having an integral ratio of 2:1, or 60 and 30 cycles. In Europe frequencies of 50 and 25 are in use. This of course simplifies frequency transformations. He also reviewed the early difficulties in designing satisfactory 60-cycle rotary converters, a problem which has since been solved. For very large low-speed mill motors, however, the use of 60 cycles presents great difficulties. Mr. H. R. Summerhayes stated that a frequency of 60 cycles is almost universal among the small central stations. The higher reactance at 60 cycles is also an advantage in limiting current rushes during short-circuits. Prof. C. F. Scott expressed the opinion that the choice of frequency is not a problem admitting of a single solution, and there is almost no field that cannot be served either at 25 or 60 cycles. Mr. N. J. Neal described some new designs of lamp shades which greatly reduce the flicker commonly observed in illumination from 25-cycle energy and expressed the opinion that this frequency could be used successfully in general lighting. In the absence of Mr. Rushmore the discussion was closed by Mr. E. A. Lof, who stated that in all cases the origin of coordinates in the curves given in the paper is at the lower left-hand corner. Costs were not given in concrete figures because the curves are only intended to show cost ratios. Written contributions to the discussion were asked for, in view of the limited time for discussion at the meeting.

EVENING SESSION.

OZONE: ITS PROPERTIES AND COMMERCIAL PRODUCTION.

The interesting paper on ozone presented by Dr. Milton W. Franklin briefly described the several means of producing it—by chemical reactions, by the electrolysis of water and by the action of the electrostatic discharge on air or oxygen. The electrostatic process is generally regarded as one of ionization and recombination. Dissociation of oxygen appears as soon as the electrostatic field becomes so intense as to cause ionization by collision, and the free ions attach themselves to the molecules with which they collide, forming ozone. The author described the electrolytic ozonators of Berthelot, Gerard and Siemens & Halske and the electrostatic machines of De Frise and Otto without solid dielectrics. Other forms were mentioned, of the type employing solid dielectrics, but all of these forms are intended for large-scale production at high intensity, for such applications as the purification of drinking water. The value of ozone for purifying the air in crowded localities or where there is inadequate ventilation has resulted in the design of ozonators which operate at lower intensities, suitable for household or any other general use. Ozone is an allotropic form of oxygen, of the formula O_3, and is a faintly bluish gas with a pungent characteristic odor. It liquefies under a pressure of 125 atmospheres at the temperature of boiling ethylene, as a dark blue liquid with highly magnetic properties. Both the compressed gas and the liquid are highly explosive. Ozone is stable at ordinary temperatures when remote from organic or other oxidizable substances, but decomposes readily at higher temperatures and instantaneously at 260 deg. It is a most active oxidizing agent because it performs at ordinary temperatures many reactions which cannot be accomplished by oxygen without the addition of heat. Its most important commercial applications lie in the purification of air and water.

Discussion.

Much interest was manifested in the paper, and it was discussed by Messrs. C. E. Skinner, M. O. Troy, J. L. Woodbridge and W. L. R. Emmet. The successful application of ozone to the purification of drinking water was stated by Mr. Skinner to be well established, and he mentioned the use of a small machine for this purpose in a Pittsburgh hospital, where it is also employed to purify the air in rooms which patients have just vacated. This machine produces highly concentrated ozone, and a person who on one occasion inhaled the gas direct from the outlet was rendered temporarily unconscious. Mr. Skinner stated that while the effect of mild ozone on consumptives is probably beneficial, experiments made on guineapigs show that the effects may be reversed by over-treatment and an excess of ozone is likely to be dangerous.

Mr. Troy stated that the production and use of ozone have been placed on a very broad basis in Europe, where the development is much ahead of that in this country. The electrical method of production, he said, is by far the most efficient. A few years ago the use of ozone was exploited in America by numerous medical quacks, with the result that its real merits were obscured by the opprobrium cast upon the whole subject by the regular medical practitioners of the country, and by the neglect of medical and scientific societies. The subject now needs the consideration of engineers generally. Besides the use of ozone as a sterilizing agent, the speaker said that possibly it has uses in the manufacture of linoleum, oils and varnishes.

Dr. Franklin explained that ozone, like nearly all medicines, is a poison. If taken in properly restricted quantities it is very beneficial, but taken in excess it is harmful and possibly dangerous. Concentrated ozone, he said, would burn the mucous membranes and destroy the lungs; hence the necessity for using it with great care and intelligence. The purification of water by ozone is accomplished by subdividing the water to extreme fineness in a spray, which then encounters an opposite stream of ozone, the two mixing most intimately and completely. The ozonized spray is then collected and led away. If water contains organic matter, it should be filtered before being ozonized. The author described at length the advantages of disinfecting with concentrated ozone the quarters vacated by patients who have had contagious diseases, dwelling upon the great penetrating power of this gas and the comparatively small danger attending its use. In explaining its deadly effect

upon micro-organisms he showed that they are instantly reduced to ashes, carbonic-acid gas and water.

THE ELECTRIC TRACTION SITUATION IN EUROPE.

The paper by Mr. C. E. Eveleth presents the author's observations during an extended trip through England and the Continent to note the progress in electric traction, covering Holland, France, Switzerland, Italy, Germany and Sweden. Viewed broadly, the greatest fundamental differences in comparison with American conditions are observed in the much lighter train weights and lower drawbar pulls, and in general the schedule speeds for suburban service are considerably lower also. In England there seems to be still some difference of opinion concerning the relative merits of single-phase and direct-current operation, but the majority seems to favor the latter and nearly all the new projects will employ that system. A 3500-volt direct-current locomotive has already been in operation there for a year.

Discussion.

Mr. B. G. Lamme opened the discussion and gave specific comparisons of electric locomotive practice in Europe with some of the notable types of locomotives in service in this country, emphasizing the much greater drawbar pull for both maximum and continuous service over here and also pointing out that the combined locomotive development in all Europe does not equal in capacity that on any one of several large trunk-line electrifications in America, such, for example, as the New Haven system with 106 locomotives of 146,000-hp total rating. The speaker stated that high peripheral rotor speeds seem to have appreciably diminished the vibration on 15-cycle single-phase locomotives. He objected to some of the German methods of locomotive control, such as rocking the brushes or using induction regulators in place of the controllers now standard over here, characterizing such methods as fads.

Messrs. E. F. W. Alexanderson, C. F. Scott and W. B. Potter continued the discussion. Mr. Alexanderson pointed out that the latest practice in European locomotive design is following the lines of established American practice, which represents the most advanced state of the art. Mr. Scott described the 22,000-volt, three-wire distribution scheme which will be used on the extensions of the New Haven system, stepping up from the generator pressure of 11,000 volts with auto-transformers. Mr. Potter spoke of the economic value of self-propelled motor cars for use on trunk-line branches with thin traffic, where electrification would be prohibitive in cost.

FREIGHT-TRAIN TESTS ON AN ELECTRIC INTERURBAN RAILWAY.

Mr. S. T. Dodd presented a paper describing a series of tests made upon electric locomotives in regular freight service on the Fort Dodge, Des Moines & Southern Railway. The object of the tests was to obtain a set of performance records under ordinary service conditions for checking the theoretical formulas employed in calculating train performance and energy consumption and showing what variation from standard figures must be allowed for in ordinary practice. The author concluded that a train resistance of 15 lb. per ton is a fair average for the conditions as a whole encountered, that the allowable rate of acceleration may be as low as 1/10 mile per hour per second, and that the available tractive effort for acceleration is not more than 80 per cent of the maximum effort at the point of driver slip.

Discussion.

Prof. C. F. Scott complimented the author on the presentation in such thorough style of a valuable set of tests for the use of traction engineers and asked if the record curves shown on the diagrams were traced automatically or plotted from periodical readings. Mr. Dodd replied that an automatic curve tracer was employed in all cases. No other discussion took place and the meeting adjourned.

UNDERGROUND CONDUITS.

At a regular meeting of the Boston branch of the American Institute of Electrical Engineers on May 15 Mr. C. T. Mosman, engineer of the General Electric Company at Boston, read an exhaustive paper upon "Underground Conduits and Cables." The paper, which is printed in full in the May *Proceedings* of the Institute, presented the detailed methods of determining the temperature conditions in a line of fiber conduits laid in cement and serving a textile mill. The tests were carried out with the co-operation of Messrs. William Clark, George A. Burnham and S. C. Coy, and a large number of observations were taken and curves plotted in connection with the determination of the cable size and permissible load per cable in extending the transmitting capacity of the system. On account of geographical limitations the conduit was built with eighty-one ducts, laid nine wide and nine deep, making the resulting conditions somewhat unusual. Certain sections were located inside a mill basement, with three sides exposed to the air, while other portions were below ground. Temperature measurements were made by thermometers placed on the cable sheaths and by calibrating iron wires for resistance and temperature changes, the wires being drawn into the ducts and supplied with energy from an external source. Copper exploring coils were also used in determining the temperatures at specific locations in the ducts, and other tests were made with the ducts and cables subjected to forced draft cooling.

The author concluded from the tests that any portion of the conduit line in question might be safely operated at about 2.5 watts loss per foot of duct with natural ventilation and at about 4 watts loss per foot with forced ventilation, provided all light-loaded cables are located at the center of the conduit with the heavier loaded cables in the outside ducts. It appeared that cables heavily loaded should not be placed in the top ducts on account of the natural tendency for the entire system to elevate the temperature of these ducts above the rest. The loss of 2.5 watts per foot corresponded to about 475 amp load on the 1,000,000-circ. mil cables involved, and the 4 watts loss to about 600 amp. Separation of lead sheaths in manholes was advised, including the wrapping of all cables in manholes with asbestos tape afterward treated with silicate of soda, together with the use of fiber duct for insulating against sheath voltages.

Discussion.

The paper was discussed by Dr. A. E. Kennelly, Mr. L. L. Elden, Prof. W. L. Puffer, Mr. William Clark, Mr. James Vahey, Mr. E. N. Lake, Mr. D. A. Harrington and Mr. G. W. Palmer, Jr. Dr. Kennelly pointed out that the paper gave data from which the thermal resistivity of a conduit can be computed, assuming that the external temperatures are known, and touched upon the possibilities of hollow ducts in place of relatively expensive forced-draft systems.

Mr. Elden said that the experience of the Boston Edison company indicates that from twelve to sixteen ducts constitute the maximum number which should be installed in one group and particularly brought into one manhole in city service. The fact that maximum station loads last only one hour in New England favors the liberal rating of cables. In central station work the variety of cables required permits arrangement to facilitate radiation. The primary and secondary cables of the Boston system show little evidence of warming with the loads carried, but at substation exits where large numbers of direct-current cables are brought out in groups the heating is more noticeable. In some cases the company operates at more than four times the peak load indicated in the paper. Mr. Elden pointed out that in many cases readings show temperature rises in cables of only from 10 deg. to 20 deg. C., but stated that a 40 deg. rise had been measured upon cables forced to

carry heavy loads, typical instances being a No. 4-0 single-conductor cable carrying 300 amp, a 750,000-circ. mil cable carrying 750 amp direct current, and a 1,000,000-circ. mil cable carrying 800 amp for a long period. A 50-deg. rise had been noted in a 1,000,000-circ. mil single-conductor cable carrying 1000 amp for three hours. Manholes rarely show a rise of over 20 deg. C. A test made upon a 1,000,000-circ. mil two-wire concentric cable carrying 1000 amp continuously showed that in the first hour the sheath temperature rose 10 deg., in the second 25 deg, and in the third, 40 deg. The conductors inside showed corresponding rises of 20, 40 and 60 deg. Small cables save money from the heating point of view. Cables can safely be run at much higher loads during the winter, although few engineers seem to realize this point, which is valuable in handling peak loads. In Boston the company has little trouble from sheath currents, seldom getting over 10 per cent of the full-load current of the cable in the sheath. Frequent bonding of sheaths is desirable, although transmission cables are not bonded to low-tension cables where a grounded neutral is used.

Prof. Puffer pointed out that the tests show that an allowance of 2000 circ. mil per amp, or 600 amp per square inch, corresponds to the 2.5 watts loss per foot condition, while an allowance of 1700 circ. mils per amp, or 775 amp per square inch, corresponds to the 4-watt loss condition. He emphasized the difficulties of making heat measurements in conduits. Mr. Lake spoke of the enlarged radiating surfaces of square ducts, the difficulties due to dampness and the value of shelving in manhole construction, and Mr. Harrington urged the inspection and better control of underground conduit conditions, favoring forced-draft service. Mr. Palmer emphasized the great importance of keeping conduits dry and questioned the insolubility of sodium silicate under damp conditions.

PROPOSED ORDINANCE TO REGULATE THE DAMAGE FROM ELECTROLYSIS.

Electrolytic damage to sub-surface metallic structures, caused by stray currents from street railway return circuits, is receiving much attention from the present city administration in Chicago. The subject has been studied by the Board of Supervising Engineers, and there has also been considerable correspondence on the question between the city departments, the board and the traction companies, but the most definite proposal for a remedy yet advanced is contained in an ordinance which has just received the approval of the Council committee on gas, oil and electric light. This ordinance was prepared by the corporation counsel at the request of Mr. Ray Palmer, the new city electrician, who has made investigations of electrolysis in both Chicago and Milwaukee. The new ordinance is much more stringent than the existing one, which has not been strictly enforced. Mayor Harrison presented this ordinance to the Council on April 22, and it was referred to the committee on gas, oil and electric light, which gave a public hearing on May 2, when the city electrician gave the committee the benefit of his views. He emphasized the seriousness of the present situation and asserted that immediate measures should be taken to reduce the damage now being done. Some considerable portion of the waste of water from the city mains, he stated, is the result of electrolytic damage. Damage also to lead-sheath cables, gas mains, steel buildings and steel bridges has been reported.

The proposed ordinance requires that all uninsulated return circuits shall be of such current-carrying capacity and so arranged that the maximum potential difference between any point on the return system and the supply station shall not exceed the limit of 12 volts, and the maximum difference between any two points on the return system which are 1000 ft. apart shall not exceed the limit of 1 volt. The ordinance also provides that a proper system of return conductors must be so installed and maintained as to protect all metallic work from electrolytic damage. The flow of return current on pipes and cable sheaths is limited to the following densities: 0.5 amp per pound-foot for calked cast-iron pipe, 8 amp per pound-foot for wrought-iron pipe and 15 amp per pound-foot for standard lead-sheath cables. Uninsulated return-current systems must be equipped with pressure wires and recording voltmeters for noting the potential differences between the station negative bus and at least four extremes on the return system in the district supplied by the station. Bond connections from sub-surface structures to the negative bus shall not be permitted to return more than 10 per cent of the total station output and must be provided with recording ammeters and automatic overload reverse-power circuit-breakers. All record charts must be always accessible to the city officials. The penalty for violation of the ordinance after six months from the date of passage is a fine of from $50 to $200 for each offense, it being provided that each day's delinquency shall constitute a separate offense.

Mr. Palmer stated to the committee that electrolytic damage was practically unknown in Europe, for the reason that preventive measures, such as those embodied in the proposed ordinance, have long been in use there. The maximum potential difference allowed between any two points of a return system under the present ordinance is 25 volts, but it is said that a difference as great as 80 volts has been found on some of the Chicago elevated railway lines. It is possible that the proposed ordinance if adopted will mean the erection of more substations, and it is certain to involve a large expenditure by the railway companies, probably between $4,000,000 and $5,000,000. The city electrician regards this large investment as justifiable, however, in view of the great amount of property which is threatened with electrolytic damage. In his opinion it will take four or five months to install the protection necessary to comply with the ordinance. He also expressed the opinion that the so-called drainage system of preventing electrolysis is only partially effective. At the conclusion of Mr. Palmer's explanation, the committee unanimously voted to recommend the new ordinance to the Council, but Chairman Cermak, it is stated, will confer with the corporation counsel in reference to questions connected with its legal enforcement, if adopted.

At a meeting of the committee held on May 16 Mr. W. W. Gurley, for the Chicago Railways Company, said that his company believed that the proposed ordinance is not a reasonable one. It is not necessary to adopt such severe requirements to achieve the desired results. If the ordinance is approved and upheld in its present form, a literal compliance with it will require the companies to spend about $25,000,000. This is an impossible burden. The companies desire to remove the difficulty, the existence of which is not denied, but their experts believe that this result may be achieved to all practical purposes and still allow the companies to live, financially speaking. In any event the remedy will involve the expenditure of millions of dollars perhaps, and the companies ask the city authorities for an opportunity to go into the matter carefully.

Mr. William H. Arthur, representing the elevated-railway companies, thought the cost to each of the elevated companies, if the proposed ordinance is upheld, might be from $5,000,000 to $7,000,000. He said that perhaps a practical system of protection could be devised at one-tenth or less of the cost of the proposed system.

Mr. Palmer said that under the ordinance now in force the companies are supposed to operate their return circuits with a maximum allowable drop of 25 volts, but as a matter of fact this limit is not observed, readings showing a drop as high as 80 volts having been obtained on tests made during recent electrolytic surveys. The maximum allowable drop under the proposed ordinance is 12 volts. In Eng-

land this limit under the Board of Trade rules is 7 volts, and in Germany it is 2.5 volts average, or 7 volts maximum. The speaker said that the situation is a serious one and one which must be cleared up. If the English electric railways can be operated with a maximum drop of 7 volts in the return circuits, the same precautions can be used in Chicago. Mr. Gurley remarked that the bad conditions in Chicago are probably on the portions of the lines that have not yet been rehabilitated under the 1907 ordinances.

Mr. Palmer, continuing, said that the proposed "drainage system" would not prove efficient. To install it would simply be putting off the evil day. He exhibited a sample of water pipe that was badly pitted and corroded owing, as alleged, to electrolytic action. The city electrician contended that the companies had been given ample time already to devise a plan of meeting the situation, and he recommended to the committee that the ordinance be reported to the City Council for passage.

Mr. Arthur said that it was only fair to permit the experts for the companies to come in and talk over the matter with the committee and the city electrician. Surely this would be a better course than to force the companies into litigation. The city electrician retorted that the railway companies are simply procrastinating and that the large amounts of money mentioned by the lawyers were brought in to scare the city authorities.

Mr. James F. Meagher, for the People's Gas Light & Coke Company, raised a laugh by saying that, strangely enough, the city and the gas company are on the same side of this question. He counseled moderation and suggested that a careful effort be made to arrive at some mutually satisfactory conclusion.

Alderman Long, of the committee, said he thought the companies might be allowed a little more time, and a representative of the Illinois Tunnel Company added his voice to the plea for an extension of time. A letter was read from the Board of Supervising Engineers, Chicago Traction, mentioning the elaborate investigation it has made of the ever-present subject of electrolysis and saying that it believed that the rehabilitated portions of the street-railway systems of Chicago are far superior, in the matter of preventing the escape of electricity, to those of most other American cities. The board remarked that the new ordinance is a far-reaching one, but made no very decided comment on it. On motion of Alderman Kearns the disposition of the ordinance was laid over one week. The companies were told that they might bring in their experts and lay a counter proposition before the committee.

PUBLIC SERVICE COMMISSION NEWS.

NEW YORK COMMISSION, FIRST DISTRICT.

The Public Service Commission and its engineers during the week made a tour of inspection of the lines of the New York, Westchester & Boston Railroad Company between New York City and New Rochelle, which will soon be open for operation. This company is controlled by the New York, New Haven & Hartford Railroad Company. It has recently completed that part of its line between 177th Street, in the Bronx, and New Rochelle. Construction of the line from a point near New Rochelle to White Plains is also well advanced. It is expected that operation will begin early in the summer.

NEW YORK COMMISSION, SECOND DISTRICT.

Through the intervention of the Public Service Commission for the Second District, the difficulties between the village authorities of Homer, Cortland County, and the Cortland County Traction Company, which furnishes light in that village, have been adjusted. On the contract under which the company had been furnishing street lighting to the village the charge was approximately 25 cents per lamp per night on a moonlight schedule. The Village Board determined to construct a municipal plant for the lighting of the streets and also to enter into competition with the existing company for commercial lighting throughout the village. The consent of the commission was necessary for the village to enter the commercial lighting field, and at a hearing held at Homer on the application of the village for this consent Chairman Stevens, who presided, succeeded in bringing the village officials and the lighting company to an understanding. Both agreed to abide by the decision which Chairman Stevens would make as to the price to be paid for street lighting. After going fully into the merits of the case the chairman decided that 13 cents per lamp per night was a proper and reasonable charge. This has been accepted by both sides, and a satisfactory lighting contract has been executed. For the next five years street lamps are to be furnished at the rate of 13 cents per lamp per night until 1 a. m. Commercial rates are not to exceed 10 cents per kw-hr. with 10 per cent discount for cash payments within ten days.

The commission has received an application from the Red Hook Light & Power Company asking for a rehearing on the order made by the commission directing it to extend its lines to provide lighting for Christ Lutheran Church at Bingham's Mills, in the town of Germantown, as required by the provisions of the franchise originally granted to the company. The complainants also proved at the hearing that there was a contract made with a former general manager of the company that service would be extended to the church when it was wired for lighting. The Red Hook company takes the ground that the proceedings to enforce the provisions of the contract should not be brought before the commission but in an action for damages in the courts, and that the commission could require the company to extend its line to the church only on the theory that public necessity and convenience required it. The company alleges that if it complied with the requirements of the order a loss of several hundred dollars per year would result. As to the requirement in the franchise, the petition for rehearing alleges that no specified time was provided when the main line in the town of Germantown should be completed.

MARYLAND COMMISSION.

Judge Bond, in the federal court at Baltimore, recently issued an injunction restraining the Public Service Commission from enforcing its order requiring the Brooklyn & Curtis Bay Light & Water Company to lay water mains along the street of the village of Brooklyn. The company says that the privileges granted in its charter are discretionary and not mandatory, and that the attempt to make it lay mains from its plant in South Baltimore to Brooklyn, about a mile away, is a violation of its rights and privileges under the Constitution of the State of Maryland and the Constitution of the United States. The case is of special interest in that it marks the first instance in which the court has restrained the commission from carrying out one of its orders.

MICHIGAN COMMISSION.

The State Railroad Commission of Michigan has approved the articles of incorporation of the Peninsula Power Company, of Madison, Wis., and has given permission to it to incorporate under the laws of Michigan, as well as to issue $1,000,000 in bonds. The company was already incorporated in Wisconsin with a capital stock of $850,000. It is the intention to construct a dam and build a water-power plant on the Menominee River. Prof. D. W. Mead, dean of the engineering department of the University of Wisconsin, is general manager and chief engineer of the company and the greater part of the stock is held by members of the faculty in that institution.

Current News and Notes

BYLLESBY DELEGATION AT SEATTLE.—Messrs. H. M. Byllesby & Company and affiliated companies will be represented by twenty-four delegates at the Seattle convention of the National Electric Light Association. Mr. Henry M. Byllesby and Mr. Arthur S. Huey will head the delegation, which will contain central-station men from twelve states.

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M. I. T. GRADUATE SCHOLARSHIPS.—The committee on graduate scholarships at the Massachusetts Institute of Technology has recommended scholarships for Messrs. R. D. Huxley, A. L. Matte, L. C. Tomlinson, E. L. Bray and H. E. Dexter, who are candidates for advanced degrees in electrical engineering at the institute. Three of these young men are candidates for the degree of doctor of engineering.

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TELEPHONES FOR TRANSATLANTIC LINERS AT THEIR PIERS.—The New York Telephone Company has extended its field of activity to transatlantic steamers at their piers at New York. Coin box telephones have been installed on several ships of the Cunard Line, and when these reach their pier representatives of the telephone company immediately establish connection with the shore service by plugging a flexible cable from a box on the wharf to one on the ship. Passengers are then enabled to telephone to friends before disembarking, or may use the service for such other purposes as desired.

* * *

MERCHANTS' ASSOCIATION COMMITTEE ON PROTECTION OF INDUSTRIAL PROPERTY.—The Merchants' Association of New York City has appointed a new committee on the protection of industrial property, and Mr. Arthur von Briesen has been made chairman. The full committee consists of eighteen members, all of whom with the exception of two are lawyers, and includes some of the leading authorities in the country upon patents and copyrights. The committee has jurisdiction over legislation relating to patents, trade-marks and copyrights and over questions concerning the protection of industrial property arising in connection with treaties and conventions.

* * *

SPECIAL CARS TO SEATTLE.—Following the meeting of the executives and managers of the properties owned by Henry L. Doherty & Company, to be held at Denver, Col., June 4 to 7, a party numbering thirty or forty will board two special cars for Seattle, Wash., to attend the National Electric Light Association convention. The Doherty special cars are to leave Denver Friday evening, June 7, going by way of the Burlington and Northern Pacific railroads and reaching Seattle Monday morning, June 10. It was first planned to attach these cars to the St. Louis N. E. L. A. special train, but to make this connection would have entailed shortening the Denver sessions by a day or two. No program has yet been announced for the Doherty convention, but of the subjects to be discussed it is learned that a large share of the time is to be devoted to the matter of welfare work for employees.

* * *

VALUATIONS OF CHICAGO ELEVATED-RAILWAY PROPERTIES.—At a long meeting of the local transportation committee of the City Council of Chicago on May 17 the aldermen listened to explanations from the real-estate experts of the city and the elevated-railway companies, who are widely at variance in their estimates of real-estate values to be used as a part of the valuation preliminary to an agreement with the city permitting the consolidation of the elevated railways. There was a long discussion of the complicated subject of real-estate damages due to the erection of the elevated-railway structures, and not much progress was made. The experts will endeavor to tabulate their reports so that a more direct comparison can be made in detail. The estimated real-estate and right-of-way valuation of the city's expert is nearly $30,000,000 less than that of the companies' expert.

* * *

THE POPULAR CENTRAL STATION.—The healthy good will of the populace toward the Rochester (N. Y.) Railway & Light Company is attributable largely to the recognition by the management of its obligation to the community which it serves. A recent example of the company's attitude toward the public is the following quotation from a letter of the company's general manager, Mr. James T. Hutchins, to Mr. Edgar F. Edwards, manager of the Rochester exposition: "I am pleased to be able to offer you electric power for the operation of any working exhibits, also for any illumination by exhibitors in their booths, as well as power for the general illumination of the buildings and grounds from the day the exposition opens until its close, free of charge. In addition we shall be pleased to loan, through you, to the exhibitors, such electric motors as may be necessary to the operation of any working exhibit, with the only stipulation that all wiring shall be installed by the exhibitors and be done in a manner satisfactory to the inspector of the Underwriters' Association."

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RESUSCITATION OF VICTIMS FROM ELECTRIC SHOCK.—The value of giving prompt treatment of the proper kind to victims of electric shock is well illustrated in two recent accidents. Several weeks ago Samuel Stevens and Frank Olie were walking near one of the transmission lines of the Niagara Falls Power Company, when the latter accidently touched a live chain hanging from the line and was shocked into insensibility. Mr. Stevens likewise succumbed while attempting to rescue him. Both received first-aid treatment from neighboring workmen and were soon restored to consciousness. On May 6 Samuel Ehrhardt, a porter with Buffalo Bill's Wild West Show, was walking on top of one of the animal cars in the Mount Vernon yards of the New York, New Haven & Hartford Railroad, when he accidentally came in contact with one of the 11,000-volt trolley wires. He was instantly hurled to the ground, but fortunately was seen by a police officer, who applied first-aid treatment until an ambulance was summoned. Although the victim was badly burned, the ambulance doctor stated that the prompt work of the police officer saved Ehrhardt's life.

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THE ELECTRIC VEHICLE AT BOSTON.—At a meeting of the Electric Vehicle Club of Boston on May 15 Mr. W. E. Eldredge, Boston, for the committee on the promotion of electric-truck interests, presented an exhaustive report recommending the establishment of a modern electric trucking organization for commercial service in Boston. It was estimated that about $100,000 would be required to make the enterprise sufficiently successful to act as a powerful force in driving the inefficient and costly horse from the field of city trucking. The committee, consisting of Messrs. Eldredge, Baker, Emery, Tirrill, Rommelfanger, Ketchum, Bowman, Taylor and Phelps, representing responsible makers of electric trucks, agreed that lack of capital and a tendency to cling to the methods and traditions of horse traction are deterring present trucking interests in Boston from changing to the more efficient equipment. The report vigorously urged the organization of an independent teaming company whose problems might be specially investigated by the electrical engineering department of the Massachusetts Institute of Technology, and from whose operation data of world-wide interest might be secured. It was pointed out that there are already over forty electric delivery companies in successful operation in this country and England.

"Freak" Public Service Complaints.—Among the freak communications of which the New York Public Service Commission receives a large number was one from a Third Avenue resident of New York City who asked for information "from the best authority possible" as to the official date for the opening of the straw-hat season for men. Another was from a young woman in Buffalo who complained of a very bitter and threatening letter sent to her by a New York attorney.

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SOCIETY MEETINGS.

Pennsylvania Electric Association.—The annual convention of the Pennsylvania Electric Association will be held at Bedford Springs, Pa., on Sept. 4, 5 and 6. The president of the association is Mr. R. S. Orr, Pittsburgh, and the secretary is Mr. Thomas Sproule, Philadelphia.

* * *

Southern Jovian Convention.—A convention of the Sons of Jove of Virginia, North Carolina, South Carolina, Georgia and Florida will be held at Wrightsville Beach, Ga., on July 6. This will be one of the largest rejuvenations ever held in the South. Special cars will be chartered from Atlanta to Wrightsville Beach.

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Railway Telegraph Superintendents.—The thirty-first annual meeting of the Association of Railway Telegraph Superintendents will be held at the Waldorf-Astoria Hotel, New York, June 4-7. The president of the association is Mr. G. A. Cellar. The secretary is Mr. P. W. Drew, 112 West Adams Street, Chicago.

* * *

Boston A. I. E. E. Officers.—At a regular meeting of the Boston Section of the American Institute of Electrical Engineers on May 15 the following officers were elected for the ensuing year: Chairman, Mr. F. P. Valentine; vice-chairman, Dr. Harold Pender; secretary and treasurer, Mr. G. A. Rodenbaeck; executive committee, Messrs. W. L. Hooper, E. C. Morse, Sidney Hosmer and R. W. Adams.

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Portland A. I. E. E. Meeting.—In our report on May 11 of the Pacific Coast meeting of the American Institute of Electrical Engineers it was stated that Mr. O. B. Coldwell, as chairman of the Portland Section, presented a loving cup to President Dunn. Mr. Coldwell acted for the section in this connection, but not as its chairman. The present chairman of the section is its former secretary, Mr. F. D. Weber.

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Philadelphia I. E. S. Meeting.—The last meeting of the Philadelphia Section of the Illuminating Engineering Society was held on May 17, the attendance being 187 members and guests. Officers of the section for the ensuing year were elected as follows: Chairman, Prof. A. J. Rowland; secretary, Mr. L. B. Eichengreen; managers, Messrs. J. D. Israel, F. N. Norton, R. F. Pierce, George A. Hoadley and E. B. Gillinder.

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Fall Convention of New England N. E. L. A. Section.—The fall convention of the New England Section of the National Electric Light Association will be held in Boston on Oct. 10 and 11. An attractive program is being arranged, and details of the papers assigned will be printed later. The convention will be held in the midst of the Boston 1912 Electric Show period. Miss O. A. Bursiel, 149 Tremont Street, Boston, Mass., is secretary of the New England Section.

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Los Angeles A. I. E. E.—At a meeting of the Los Angeles Section of the American Institute of Electrical Engineers held on April 30 sixty-five members and visitors were present. Mr. C. E. Johnson presented a paper entitled *Some Features of the Design and Construction of Dynamo-Electric Machines,* and Mr. W. S. Hoag read a paper on *Motor Application.* Among those who took part in the discussion were Prof. R. W. Sorenson and Messrs. H. Hall, E. B. Taeubert and C. E. Hogle.

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Cook County Electrical Contractors in Session.—About sixty-five electrical contractors of Cook County attended a dinner at a Wabash Avenue restaurant in Chicago on the evening of May 15. Mr. R. C. Kreider presided, and after the dinner there were speeches by several visitors, including Mr. C. M. Goddard and Mr. F. E. Cabot, of Boston; Mr. A. M. Schoen, of Atlanta; Mr. Ernest McCleary, of Detroit; Mr. G. M. Sanborn, of Indianapolis, and Mr. V. H. Tousley, of Chicago. Messrs. Goddard, Cabot and Schoen discussed matters relating to the National Electrical Code and improved methods of electrical construction. Mr. Tousley explained briefly the revised rules and regulations of the Chicago Department of Electricity, and Mr. Sanborn dwelt especially on the use of the universal data and sales book of the National Electrical Contractors' Association. A general discussion followed on the subject of whether, in concealed wiring, the use of conduit or knob-and-tube work is preferable.

* * *

Washington A. I. E. E. Meeting.—The Washington Section of the American Institute of Electrical Engineers held its annual business meeting on May 14. The officers of the past year were re-elected as follows: Chairman, Mr. Earl Wheeler; secretary, Mr. H. C. Eddy; executive committee, Messrs. J. H. Finney, J. H. Hanna and C. B. Mirick. The section has affiliated with the Washington Academy of Sciences. Other organizations in the academy are: The Anthropological Society of Washington, the Washington Society of the Archæological Institute of America, the Biological Society of Washington, the Botanical Society of Washington, the Chemical Society of Washington, the Washington Society of Engineers, the Entomological Society of Washington, the Society of American Foresters, the National Geographic Society, the Geological Society of Washington, the Columbia Historical Society, the Medical Society of the District of Columbia and the Philosophical Society of Washington. Chairman Wheeler was elected delegate to the academy.

* * *

Institute of Radio Engineers.—The first regular meeting of the Institute of Radio Engineers, which now represents the combined interests and membership of the Society of Wireless Telegraph Engineers and the Wireless Institute, was held at Columbia University on May 13. The new constitution was adopted and the following officers were elected for the remainder of 1912: President, Mr. R. H. Marriott, New York; vice-president, Mr. F. Lowenstein, New York; secretary, Mr. E. J. Simon, New York; treasurer, Mr. E. D. Forbes, New York; managers, Messrs. G. W. Pickard, Boston; J. L. Hogan, Jr., New York; L. Espenschied, New York, and F. Fay, New York; editor of publications, Dr. L. Cohen, Brant Rock, Mass. Standing committees as follows were appointed by the chair: On standardization, Messrs. Stone, Lowenstein, Pickard and Goldsmith; on papers, Messrs. Cohen and Goldsmith; on publicity, Messrs. Hogan and Simon. Mr. Marriott read the editorial on "Standardization in Wireless Telegraphy" from the *Electrical World* of May 4, and commented on the need of action in this line. A number of symbols and definitions were freely discussed, and it was decided to place these in the hands of the standardization committee for revision, amplification and adoption at the earliest possible moment. The next meeting was set for Monday evening, May 20, at which time the Berlin treaty, together with the various international recommendations concerning its measures, were to have been considered.

LARGEST CENTRAL STATION IN THE STATE OF KANSAS.

Modern Turbine Generating Plant of 8000 Kw Rating of Kansas Gas & Electric Company at Wichita, Kan.

Arrangement for Operation by Two Attendants—Gas and Oil-Burning Furnaces Fired from Rear and Beneath —Energy Transmitted at 60,000 Volts.

THE "largest central station in all Kansas," the new turbine generating plant of the Kansas Gas & Electric Company at Wichita, takes its place also among the most modern and carefully planned stations in the country, including in its design many interesting features. One of the aims of the engineers in laying out this 8000-kw plant was an arrangement such that it might be operated by only two men, one to tend the fires and watch over the auxiliaries and the other to manipulate the switchboard and supervise the turbines. To this end the switchboard, all remote-controlled, is not mounted on the usual gallery but is dropped to the turbine-floor level, while the oil and gas burners for the boilers are so arranged beneath the furnaces that they can be tended from the main turbine-room floor. A glance at Fig. 1, the general view, and Fig. 2, the sectional elevation of the station, will show how the various operating parts of the plant have been disposed in order to make them all accessible from one floor. All pressure gages are brought to the tender's station in front of the burners beneath the boilers, and provision has also been made to indicate the water-column levels here, 20 ft. or more beneath the actual levels in the drums themselves.

Besides furnishing lighting and motor service for the residents of Wichita, a progressive city of 60,000 population, the plant about to be described produces electrical energy for operating the system of electric railways centering about Wichita, transmitting at 60,000 volts to Newton and other points to the north, where electric-lighting service is also supplied.

In plan the new station measures roughly 134 ft. by 110 ft., the turbine building with its switch room occupying an area 134 ft. by 61 ft., while the boiler room is 118 ft. by 50 ft. Foundations and lower walls are all of concrete, while the superstructure is a steel framework closed with brick walls. A 200-ft. steel stack, 15 ft. in diameter, surmounts a concrete foundation constructed alongside the boiler room.

Conditions of circulating water for the condensers dictated the location of the plant at the confluence of the Big and Little Forks of the Arkansas River, about a mile from the business center of Wichita. Water from the Little Fork is very clear and the arrangement of the circulating tunnels and intakes enables the condenser supply to be taken from the small stream and returned to the main river in front of the plant.

Four of the future eight 525-hp boilers are already installed. Each of these units has 5600 sq. ft. of heating sur-

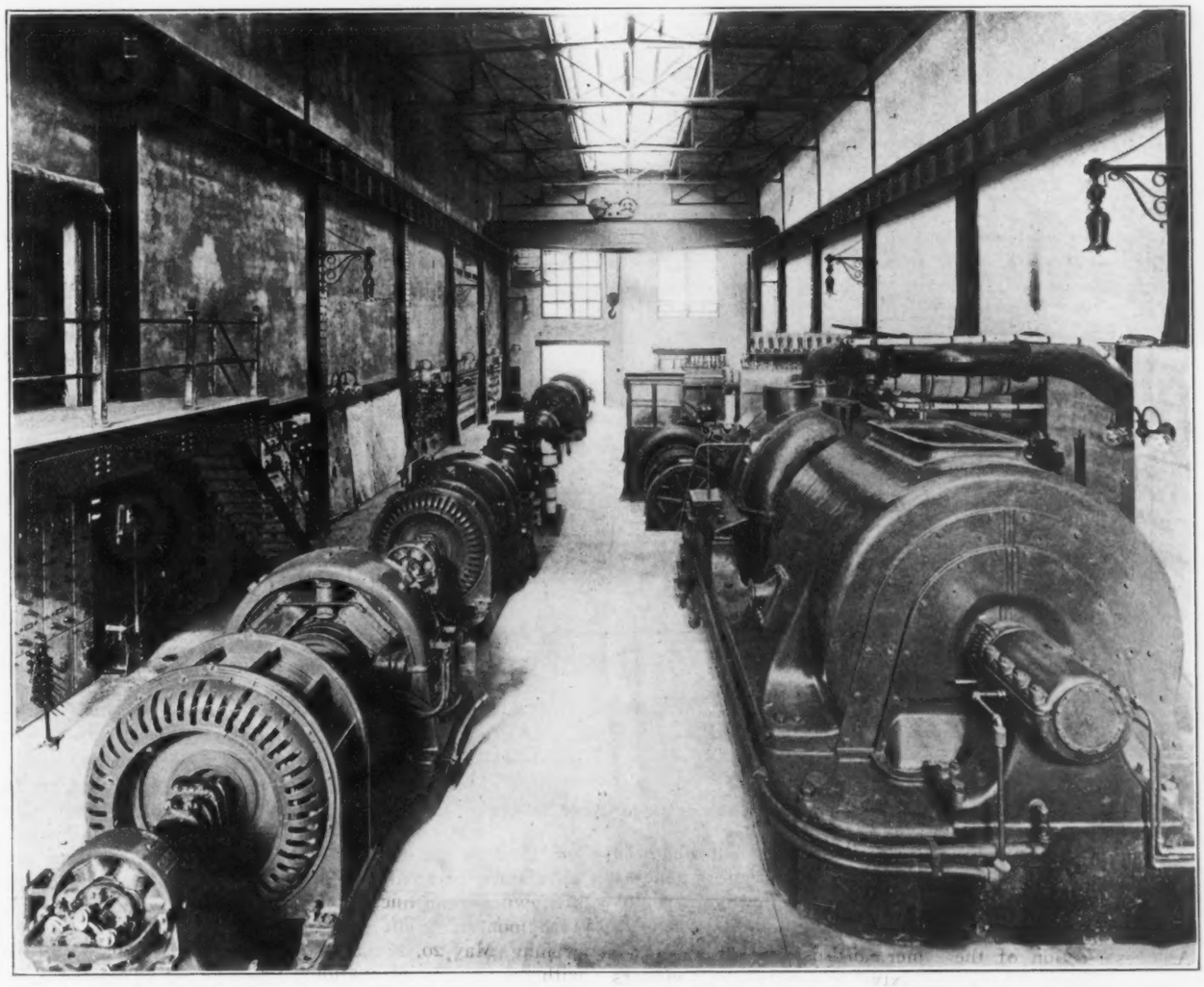


Fig. 1—Interior of Generating Station of Kansas Gas & Electric Company at Wichita, Kan.

face and is adapted to burn gas, oil or coal. Natural gas is the fuel now principally used, with oil as an emergency medium. As shown in Fig. 3, however, the upper main firing aisle in front of the boilers has been constructed for supporting future coal bunkers if necessary, and the furnaces are adapted to contain coal-burning grates.

Each 525-hp boiler is served by twenty-nine 6-in. natural-gas burners. The gas, piped in to Wichita at 30 lb. pressure per square inch, is reduced at the burners to approximately 10-oz. pressure. Fig. 2, the sectional elevation, shows the arrangement of the burners, beneath the boilers and at the turbine-room level, revealing also the spacious combustion chamber for burning the gases before passing through the boiler tubes. Each boiler is equipped with an auxiliary oil burner, fed with fuel oil by the steam pumps shown in Fig. 3 at the right of the burners. The oil is stored for emergency use in a tank outside the station, and all fuel used is automatically weighed in a Kennicott tilting meter. The outdoor storage tank has a capacity equal to twenty 1500-gal. tank cars, or 30,000 gal. of oil. A Hoskins recording pyrometer measures the temperature of the flue gases leaving each boiler. These flue gases are collected in a transverse breeching above the boiler-room roof and conveyed to the 200-ft. self-supporting steel stack, 15 ft. in internal diameter. The concrete base of this chimney is to be waterproofed and sealed, converting it into a storage reservoir, for which it is already admirably adapted.

Two 4000-kw horizontal Curtis-General Electric turbo-alternators comprise the main generating equipment of the Wichita station. Although identical in rating, one machine runs at 1800 and the other at 1200 r.p.m., resulting in a striking disparity in external dimensions and weight in favor of the higher-speed unit. These alternators generate 2300-volt, 60-cycle, three-phase energy, which is distributed directly at this primary voltage in Wichita and is stepped up to 60,000 volts for transmission to the substations.

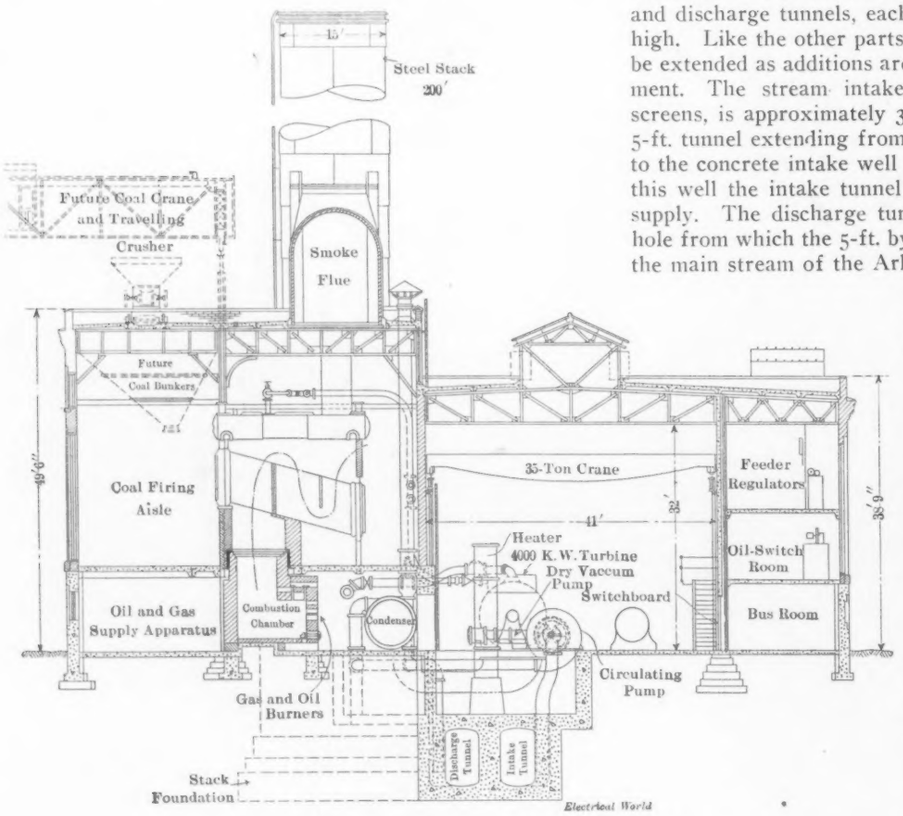


Fig. 2—Section Through Plant, Showing Under-Fired Boilers.

The turbines exhaust into Alberger surface condensers, each presenting 11,000 sq. ft. of tube area. An auxiliary path to the atmosphere is afforded by 24-in. free exhaust lines. The condensers are located just inside the boiler-room wall in front of the burners. Circulating water for these condensers is delivered from the tunnels beneath the station by engine-driven centrifugal pumps with 24-in. intake and 20-in. discharge.

Paralleling the main dimension of the station, beneath the center line of the turbines and auxiliaries, are the intake and discharge tunnels, each measuring 5 ft. wide and 7 ft. high. Like the other parts of the station, these tunnels can be extended as additions are made to the building and equipment. The stream intake gate, protected by racks and screens, is approximately 300 ft. from the plant, a 5-ft. by 5-ft. tunnel extending from the bank of the Little Arkansas to the concrete intake well just outside the building. From this well the intake tunnel beneath the station receives its supply. The discharge tunnel opens into a concrete manhole from which the 5-ft. by 5-ft. waste tunnel connects with the main stream of the Arkansas River, 100 ft. distant.

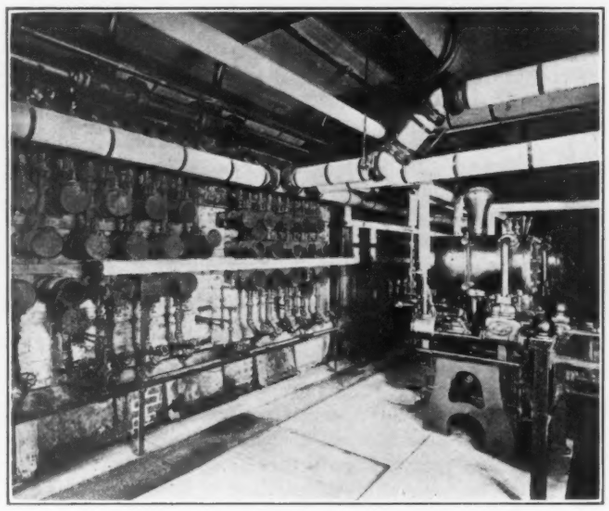


Fig. 3—Gas and Oil Burners Beneath Boilers.

In addition to the principal 4000-kw horizontal turbine units there is a 750-kw vertical Curtis-General Electric alternator set temporarily installed in the Wichita plant for reserve duty. This unit, which was removed from the old station of the Kansas Gas & Electric Company, will later be transferred to the Newton plant of the company.

Paralling the center line of the turbines and auxiliaries are the exciter sets and railway motor-generators. There are two 100-kw exciters, one driven by a Curtis turbine and the other by a 2300-volt motor. Of the four 500-kw, 550-volt motor-generator sets, each driven by a 2300-volt synchronous motor, two are adapted for use on the local 500-250-volt "power" circuit, having mid-points brought out through the medium of balancing coils. All four machines are, of course, available for 550-volt railway operation when required. A 35-ton traveling crane spans the turbine-room floor.

The switchboard is entirely of the remote-control type, all 2300-volt circuits being handled by oil switches located on the second story of the switch house. Location of the

switchboard itself on the main operating floor was made, as already pointed out, in conformity to the aim of the designers to reduce the operating force to the minimum of two men. While the station can doubtless accordingly be successfully operated during normal conditions with only two attendants, it has been thought best in actual practice to have three men always on duty here to care for any trouble

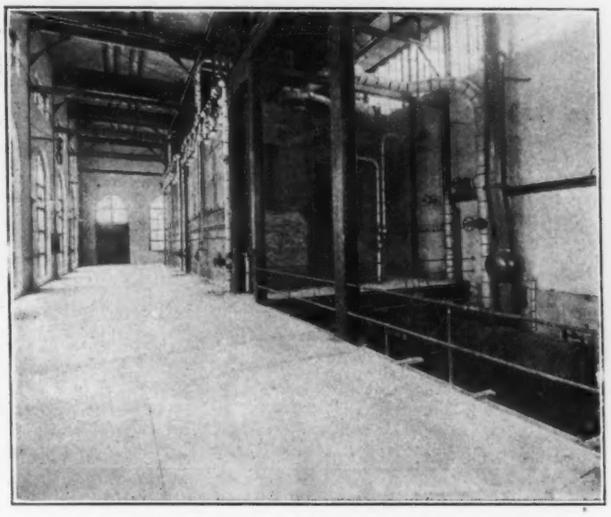


Fig. 4—525-hp Boilers and Aisle for Future Coal Firing.

that may develop. The switchboard equipment includes the generator and auxiliary panels, direct-current switches, feeder control switches and arc-circuit panels. In the space behind the switchboard are the various buses and circuits, instrument transformers, etc. Disconnect switches are liberally inserted at all points where it may become desirable to isolate active apparatus for repairs or change of connections. On the second story of the switchhouse, over the bus room, are mounted the 2300-volt oil switches, all motor-operated from the control panels on the main floor. The gallery above is taken up with the automatic feeder regulators for the local lighting circuits, generator field resistors, etc. Fig. 7 shows the arrangement of feeder in-

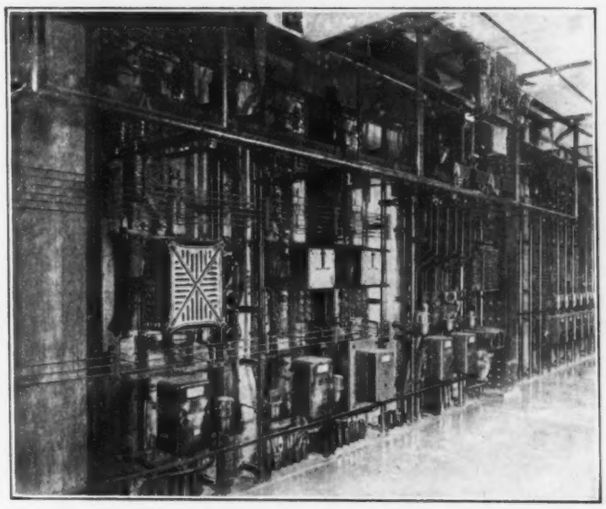


Fig. 5—Rear of Switchboard.

struments, series transformers, watt-hour meters, disconnect switches, etc. From this compartment the outgoing 2300-volt lines are led to the iron-pipe roof structure shown in Fig. 8 and by its means properly distributed to the pole arms.

One end of the switch house is occupied by the 60,000-volt apparatus feeding into the transmission line to Newton and intermediate substations. On the first floor or turbine-room level, in separate concrete compartments, are the three 600-kw, 2300-60,000-volt water-cooled transformers, the high-tension terminals of which are connected to buses leading through combination air-break switches and fuses in the upper story to the roof outlets seen in Fig. 8. These circuits are protected by General Electric aluminum-cell

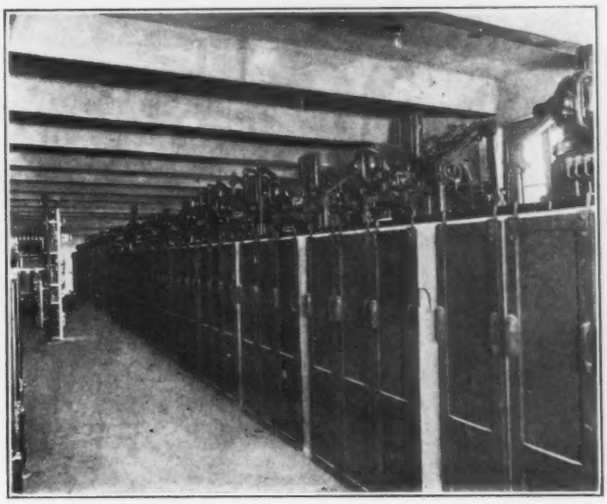


Fig. 6—Motor-Operated Oil Switches.

lightning arresters, the cells themselves being mounted in the switch compartment (Fig. 10), while the horn gaps on the roof structure are seen in Fig. 8. Thomas roof-type porcelain insulators are used for making the vertical bus and lightning-arrester entries.

The 60,000-volt transmission line extends 30 miles northward to Newton, reaching en route the towns of Valley Center, Sedgwick and El Dorado. From Newton an extension is now under construction to Halstead, 10 miles west. The transmission conductors comprise three seven-strand No. 2 copper cables, spaced at 6-ft. delta distances, and protected overhead by a ¼-in. iron ground wire, grounded at every fifth pole.

Fig. 7—Feeder Regulator Gallery.

On test under average conditions of load factor and output the Wichita plant has produced a kilowatt-hour at the switchboard on 27 cu. ft. of natural gas, which has a fuel value of about 900 lb.-Fahr. heat units per cubic foot. Operating with oil as the fuel, 235 kw-hr. was developed per 42-gal. barrel of oil. One pound of this oil, having a fuel value of 19,500 heat units, would thus produce 0.7 kw-hr.

The Kansas Gas & Electric Company serves 6400 electrical customers throughout its system at Wichita, Newton, Valley Center, Sedgwick, El Dorado and other towns. Its total connected load in motors alone on May 1 was 4600 hp, and this is growing rapidly as new industries are electrified.

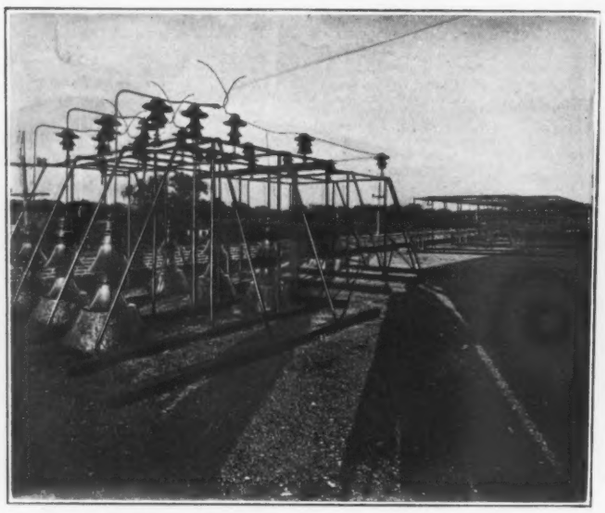


Fig. 8—60,000-Volt and 2300-Volt Roof-Exit Structure.

One profitable long-hour motor application at Wichita is sand pumping. A number of contractors have 40-hp motor-driven 6-in. pumps and at no other direct outlay than a few cents for energy secure fine river sand, which is sold locally at 15 cents per wagon load of 1½ cu. yd. An unusual application of electric heating in a community the size of Wichita is in the establishment of a local dyer and cleaner. He has more than fifty electric irons in use, besides employing motor drive on all his machines. This

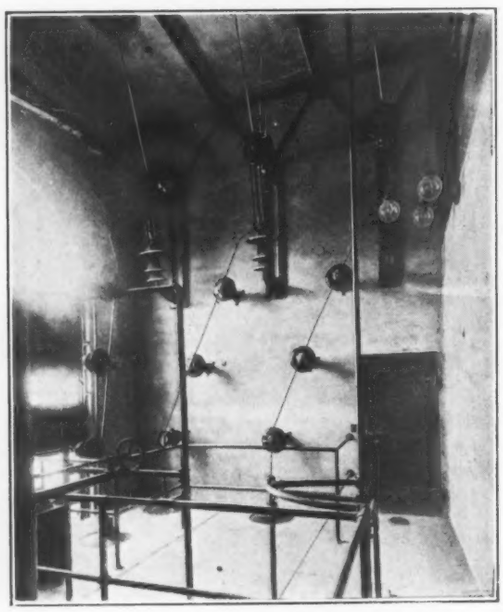


Fig. 9—60,000-Volt Buses to Roof Exit.

Kansas metropolis also has a large number of electric signs and displays, one of the most celebrated of which is the famous motto spanning the principal street near the railway stations—"Watch Wichita Win!" A new magnetite-arc "white way" has also been planned for the city, comprising nearly 300 single-lamp posts spaced at short intervals on the two main streets and so disposed that each street intersection will be lighted by two 4-amp lamps. This special lighting will be installed complete within sixty days.

The Kansas Gas & Electric Company is controlled by the American Power & Light Company, of which Mr. F. G. Sykes is president. Mr. L. O. Ripley is vice-president of the Kansas Gas & Electric Company, with offices at Wichita, and Mr. H. S. Sladen is manager at Wichita. Sargent & Lundy, Chicago, acted as engineers for the new power plant.

Fig. 10—2300-Volt Bus Construction on First Floor.

CHARACTERISTICS OF DRY BATTERIES.

At the sixty-second ordinary meeting of the Faraday Society, held on March 26 at the Institution of Electrical Engineers, London, Mr. S. W. Melson presented an interesting paper on "Dry Batteries: The Relation Between the Incidence of the Discharge and the Relative Capacity of Cells of Different Manufacture." The series of tests whose results are set forth in the paper was made for the purpose of finding to what extent the tests in general use afford a safe indication of the relative merits of different makes of cells. The cells tested were classed in four groups, A, B, C and D. A summary of results is given in the table, which shows the discharge capacity in each case in watt-hours.

DISCHARGE CAPACITY OF DRY CELLS.

No.	Discharge.	Cells.			
		A.	B.	C.	D.
1	Five minutes an hour on 50 ohms	43	40	36	12
2	Five minutes an hour on 1 ohm initial	44	26	10	3
3	Six hours per day on 5 ohms	126	63	63	46
4	Continuous at 20 milliamperes	105	47	42	31
5	Continuous on 10 ohms	64	49	35	38
6	Continuous on 100 ohms	107	73	55	38
7	Continuous on 500 ohms	70	66	..	..

The author concludes that these tests afford no reliable conclusions of relative merit and recommends that the conditions of test approach as nearly as possible to the actual conditions of working.

In the course of the discussion it was brought out that the type D cells were makes in use some six years ago, while types A and B represented the best of the recent makes. It was also stated that while in America dry cells to the very large number of some 40,000,000 are in use, the British types are nevertheless superior.

ADJUSTABLE-SPEED MOTORS.—II.

The Principles, Types and Characteristics of Direct-Current Motors for Industrial Service.

BY ALEXANDER DAWES DUBOIS.

THE first instalment of this article, which appeared in the issue of May 18, contained a brief treatment of the fundamental principles involved in variation of motor speed. Referring to these basic principles, there are three different methods of speed control—by changing voltage impressed on armature, by changing field magnetism, and by changing number of conductors in series from brush to brush. Within each one of these classes there are different systems, some of which were described in the previous instalment. Other methods are described in the following. An article in a subsequent issue will describe some combinations and comparisons between the various methods.

CONNECTING TO CIRCUITS OF DIFFERENT VOLTAGES.

(*Continued.*)

Crocker-Wheeler System.—By adopting another arrangement of voltages the Crocker-Wheeler Company developed a system which gives a strictly straight-line speed curve, the speeds increasing in arithmetical progression throughout the range in steps of about 40 volts.

The combination by which the six voltages are obtained will be made clear by reference to Fig. 9, which shows the arrangement of this form of the system when 240 volts is used for the total voltage, The standard pressure employed at the terminals of the motors is 230 volts across outside wires, which reduces the six voltages to 38 volts, 77 volts, 115 volts, 153 volts, 192 volts and 230 volts respectively. The lowest voltage is not ordinarily used as a running step in the speed range, but serves merely as a step in starting. The intermediate speeds between the voltage steps are obtained by field-circuit control, although resistance in the armature circuit may be used if the character of the load makes it desirable. The drum-type controllers used with this system are so arranged as to insert a suitable rheostat armature circuit at the time of changing voltage, and a dash-pot device short-circuits the rheostat automatically when its purpose has been fulfilled.

Using a 10-hp motor by way of example, Crocker and Arendt,[1] have given data (Table II) to illustrate the speeds

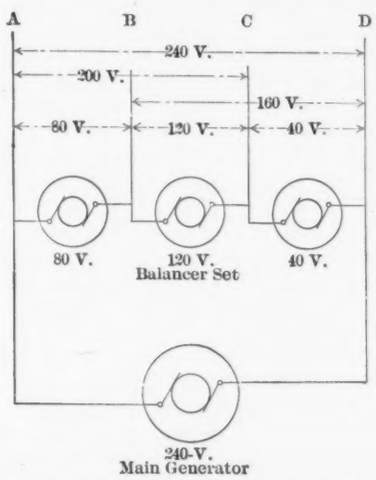


Fig. 9—Crocker-Wheeler Four-Wire Multiple-Voltage System.

and efficiencies at the several speed steps, *assuming constant rated torque.*

The speed regulation of the same motor is shown in Table III (the regulation by rheostatic control being also given).

[1] "Electric Motors: Their Action, Control and Application," by F. B. Crocker and M. Arendt.

Bullock System.—The most logical arrangement of speed steps is that of a geometrical progression in which each

TABLE II.—SPEEDS AND EFFICIENCIES.

Terminal Volts	Watts Input.	*IR* Drop in Armature and Brushes.	Counter Emf.	Speed Revolutions per Minute.	Watts Output.	Efficiency per Cent.
40	1,710	11.8	28.2	106	971	56.6
80	3,190	11.8	68.2	258	2,370	74.2
120	4,670	11.8	108.2	409	3,750	80.1
160	6,150	11.8	148.2	560	5,150	83.5
200	7,630	11.8	188.2	711	6,530	85.6
240	9,110	11.8	228.2	862	7,920	86.7

increase of speed is a certain percentage increase rather than an increase by a fixed amount. In order to have a geometrical progression with a four-wire system, a factor, r, must be chosen which will fulfil the following condi-

TABLE III.—SPEED REGULATION.

Controller Notch	MULTI VOLTAGE. Revolutions per Minute, Rated Torque.	MULTI VOLTAGE. Revolutions per Minute, No Load.	MULTI VOLTAGE. Per Cent Regulation.	RHEOSTATIC CONTROL. Revolutions per Minute, Rated Torque.	RHEOSTATIC CONTROL. Revolutions per Minute, No Load.	RHEOSTATIC CONTROL. Per Cent Regulation.
1	106	145	13.7	106	854	705.0
2	258	296	11.5	258	865	235.0
3	409	447	9.2	409	875	114.0
4	560	599	7.0	560	883	48.4
5	711	750	5.2	711	892	25.2
6	862	910	4.6	862	910	4.6

tions, where a is the lowest voltage: $ar^3 = a + ar$, $ar^4 = ar + ar^2$, and $ar^5 = ar^2 + ar^3 = a + ar + ar^2$. (The voltages available being: a, ar, ar^2, ar^3, ar^4 and ar^5.) These conditions will be satisfied with $r = 1.3247$—that

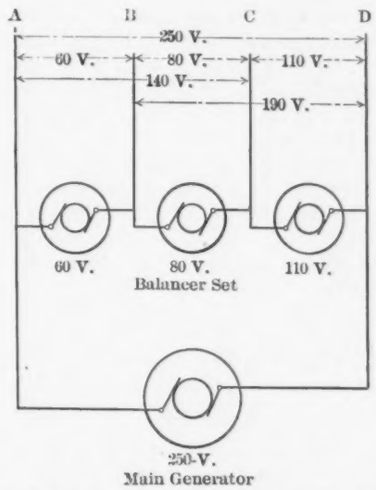


Fig. 10—Bullock Four-Wire Multiple-Voltage System.

is, if each voltage is 32.47 per cent higher than the next lower voltage the geometrical progression can be realized with four wires. For example, three voltages of 60, 79.5 and 105.3 respectively would satisfy the conditions.

The Bullock Electric & Manufacturing Company developed a commercial system in which 60 volts, 80 volts and 110 volts were adopted as being near enough to the

theoretical values. The available voltages on this basis are 60, 80, 110, 140, 190 and 250, obtained by the combinations indicated in Fig. 10. The three machines of the balancer set have voltages of 60, 80 and 110, each voltage being practically one-third greater than the preceding. The resulting speed range, by voltage control alone, is about 5 to 1. The following table, also taken from Crocker and Arendt's "Electric Motors," shows the speeds for the 10-hp motor previously cited. Rated full-load torque is assumed at all speeds.

TABLE IV.—MOTOR SPEEDS.

Terminal Volts.	*IR* Drop in Armature and Brushes.	Counter Emf.	Speed, Revolutions per Minute.	Per Cent Increase Step to Step.
60	11.8	48.2	182	..
80	11.8	68.2	258	42
110	11.8	98.2	374	45
140	11.8	128.2	485	30
190	11.8	178.2	673	39
250	11.8	238.2	900	34

This range is usually supplemented by moderate field weakening (about 33 per cent) above the highest voltage step, thus increasing the total speed range to approximately 6.5 to 1. The intermediate steps between voltages may be obtained either by armature or field-circuit control, the latter being more generally employed. The controller is of the drum type and gives speed steps of about 7 per cent each. No rheostat is inserted in the armature circuit at the transition points between voltages, as with small increments of speed it is found to be unnecessary.

VARYING VOLTAGE BY AUXILIARY MOTOR-GENERATORS.

Of the schemes involving a separate motor-generator set for each motor, three that have been commercially developed will be described. All are alike in the essential feature of supplying energy to the motor from a variable-voltage generator, a separate motor-generator set being required for each motor operated. On account of their cost and complication the practical applications of these systems are limited to very special conditions. They have been successfully employed in the operation of large newspaper printing presses, the turning of gun turrets on battleships and the driving of large rolls in steel mills.

Ward-Leonard Motor-Generator System.[1]—The simplest application of this principle is shown in Fig. 11. The variable-speed or "working" motor *WM* has its field coils connected directly to the constant-voltage supply mains, but its armature is fed with energy through an independent circuit from an auxiliary generator *D*, which is driven by

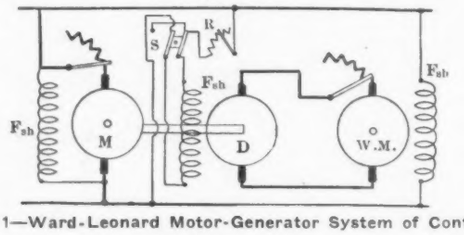


Fig. 11—Ward-Leonard Motor-Generator System of Control.

a constant-speed motor *M*. The latter is connected to the supply mains and operated as any other constant-speed motor, its function being simply to drive the generator *D* at constant speed. The voltage of the generator is varied by field-circuit control through the agency of the rheostat *R*, which is so proportioned as to reduce the voltage from maximum to zero by gradual steps. This gives motor speeds from zero to normal in one direction. The reversal of the motor is accomplished through the reversal of the generator voltage by reversing its field-circuit connections as the controller is passed over the zero position. Both machines of the generating set must be somewhat larger than the working motor, since each must carry the entire load plus the losses in the working motor and auxiliary generator respectively. The exceeding flexibility and nicety

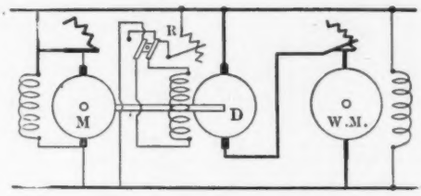


Fig. 12—Ward-Leonard "Boost and Retard" System of Control.

of control of such an equipment are at once apparent. The speed regulation is fairly good even at the lowest speeds, so that a machine may be "inched along" or run very slowly without the jerks or irregularities of speed which accompany variations of torque with armature rheostatic control.

Another advantage is to be found in the fact that the heavy motor current required to start high-torque loads is supplied at the minimum possible voltage. The line and generating station are thereby relieved of the abnormal draft of power which with rheostatic control would be wasted in the rheostat at the time of starting.

Although its excessive cost precludes the general application of such a system, its special characteristics have brought it into use on battleships, for the operation of gun turrets, where wide range and fine adjustment of speed are essential. In steel mills it has proved a successful method of driving large rolls, a flywheel being in this case an important part of the motor-generator set.

The Boost and Retard System is a modification of the preceding scheme. It reduces the first cost of equipment by reason of the smaller motor-generator set, which in the present system need have only about one-half the rating of the "working" motor. The auxiliary generator is connected in series with the working motor, as shown in Fig. 12, and serves as a "booster" or "reducer" of the line voltage. The normal voltage of this generator is equal to that of the line, so that the combination will double the line voltage when used as a booster and will annul the line voltage when used as a reducer—that is, when opposed to it. By this means the voltage at the working motor *WM* is varied at will, from zero to twice the voltage of the line. With a distributing system of 110 volts a 220-volt working motor would be used. The emf of the generator *D* is controlled by variation of the field-circuit resistance and is reversed by reversal of the field-circuit connections through the operation of a special reversing device in the field-circuit controller, the field current having first been gradually reduced to zero. When the motor-generator set is opposing the line voltage the functions of the two machines are automatically reversed. The generator *D* becomes a motor (its counter emf opposed to the line) driving the motor *M* as a generator and causing it to send energy back into the line to supply part of the energy used by the load motor.

The reversal of the main motor cannot be accomplished as in the last method by reversing the generator emf, but must be taken care of by reversal of armature connections of the load motor itself.

Since the ampere rating of the generator *D* is the same as that of the load motor, while its voltage is only half, the watt rating is one-half of that required by the load motor. Thus the motor-generator set is about half as large as that required in the preceding system.

The efficiency of this and the last-described method is,

[1] U. S. patent No. 463,802, November, 1891.

of course, impaired by the losses in the auxiliary machines, but will nevertheless average much higher than with rheostatic control.

Teaser System—In another arrangement, developed by the Bullock Company especially for the operation of rotary printing presses, use is made of the motor-generator set only for supplying low voltage to drive the working motor at the very low speeds required for "making ready" the

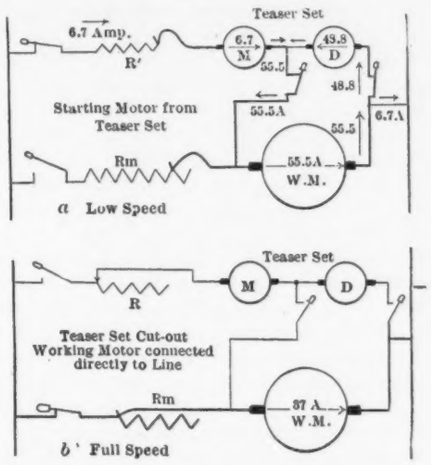


Fig. 13—Bullock "Teaser" System.

press and threading in the web. At these speeds the power consumed is comparatively small, so that a small generator set or "teaser" may be used. The higher running speeds are regulated by armature rheostatic control of the working motor. The essential features of the scheme will be understood by referring to Fig. 13.

The function of the teaser set is in reality that of a transformer. It takes a small current at line voltage into the motor end and delivers a large current at low voltage from the generator end. The working motor is by this means supplied with sufficient current to overcome the torque of the load and at a voltage only slightly greater than the *IR* drop in the armature circuit, so that only a small counter emf is required to be generated by the working motor and it runs at very low speed. The working motor is gradually accelerated by increasing the voltage of the "teaser" generator (this being done by increasing the speed of the motor *M* either by armature or field-circuit control) until the speed of the load motor is such that it can be accelerated by armature rheostatic control on the full line voltage without serious irregularities of speed. The teaser set is then cut out of circuit and the main motor is connected to the line through the rheostat *Rm*.

In a later modification of this method use is made of a compound-wound teaser generator which is found to give better results, as the former equipment was sometimes stalled by sticking of the press. The compounding serves to raise the voltage at such times and thus to insure sufficient current to develop the additional torque for carrying the press over the sticking points.

An important advantage in addition to the smooth running at low speeds obtained by this method is to be found in the great saving of power over that required by rheostatic control. By the latter method the large current necessary for starting and slow running must be supplied at line voltage, thereby involving a loss in the rheostats many times as great as the useful power.

CHANGING FIELD MAGNETISM.

It has been shown that an increase of the field flux will decrease the speed and a weakening of the field will cause the speed to increase. The weakening of a motor field reduces the full-load torque, but by reason of the accompanying increase of speed the power developed remains practically constant. All field-controlled motors are therefore inherently *constant-power* and not *constant-torque* machines. For the most important class of adjustable-speed work in shops this is the desired characteristic.

The variation of the field magnetism is most readily accomplished by means of a rheostat in series with the shunt field winding of the motor, but in at least two commercial designs the result is also obtained by varying the reluctance of the magnetic circuit.

The method of shunting part of the field current is used for cutting out the series winding of compound motors in elevator service and it may be used as a means of weakening the field of series motors.

INSERTING RESISTANCE IN FIELD CIRCUIT.

Shunt Field Control (with standard motors).—The insertion of resistance into the shunt-field circuit affords the simplest and most easily controlled of all methods of speed variation. The efficiency is very satisfactory at all speeds, since the additional resistance in the field circuit does not introduce an additional loss. As a matter of fact the I^2R loss in the field circuit is reduced by the insertion of resistance, because of the reduction of field current, while the total voltage remains constant. There are other losses, however—windage, friction and commutation losses—which cause the efficiency to drop somewhat with increase of speed through any considerable range.

This method of speed control has its chief limitation in sparking at the commutator. The current varying in the short-circuited armature coil generates an emf of self-induction to oppose the change and this opposition must be completely neutralized to insure perfect commutation. To attain this result it is necessary that each armature coil which is connected with the commutator segments passing under the brushes at any given instant shall be at that same instant moving through a magnetic field called the "commutating field," the polarity, intensity and area of which are such as to develop an emf just sufficient to arrest the current in the coil and build up a current of the same strength in the opposite direction during the time the coil is short-circuited by the brushes.

For any particular armature current and any particular strength of motor field, within certain limits, it is possible to find a suitable commutating field in the magnetic "fringe" somewhere between the poles of the motor. But any variation of either armature current or field magnetism will cause a shifting of the resultant field, so that the magnetic fringe will no longer remain suitable, in value or location, for sparkless commutation.

In the present type of adjustable-speed motor both of these quantities change, the armature current varying with the load and the strength of field varying inversely with the speed. The reactance of the armature coil also varies with the speed, but fortunately the rate of cutting the lines of force of the commutating fringe varies in the same ratio, thus automatically taking care of this characteristic provided that there is a magnetic fringe which can be utilized.

The effect of armature reaction upon the field distribution of a standard constant-speed motor is to produce a shifting or distortion of the main field, the effect becoming greater as the load is increased. If the motor field be weakened to produce higher speed, while retaining the same load, the effect of armature reaction will be increased, and if the field weakening be carried far enough the motor field may be so far distorted as to reduce the flux to zero under the leading pole tip, as illustrated in Fig. 14. If the brushes are given a backward lead the armature reaction has also a demagnetizing component which further weakens the main field.

The distortion which takes place at high speeds on weakened field is more clearly shown in Fig. 15, which gives the field distribution curves at the maximum speed of a motor

of standard construction having a speed range of 4 to 1. The solid line shows no-load and the dotted line full-load distribution. The dotted line shows that, in this motor, the zero point *A* is well under the pole tip. At the point midway between poles, where the brush is indicated, the magnetic fringe is the reverse of the polarity desired for commutation. Consequently no assistance can be had from the

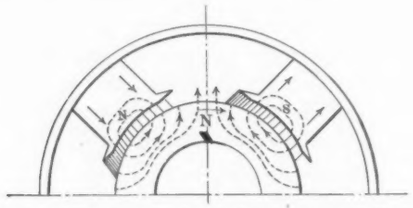


Fig. 14—Example of Distorted Motor Field.

fringe at the high speeds and at full load. At the lower speeds the fringe will assist in commutation if the brushes are shifted backward. A motor which has its brushes shifted from the central point will not be reversible without readjustment of the brushes to correspond to the new direction of rotation. It may be noted here that moving the brushes backward will shift the resultant field of the motor in the same direction, though of course not in the same amount, as the brush shift.

Another feature which is unfortunate for the designer is the fact that adjustable-speed motors with a wide speed range must have a rather low minimum speed in order that the maximum speed may not exceed good practice; and low speed calls for a large number of turns in the armature winding, which if obtained by using many turns per coil will produce a high reactance, and if by increasing the number of coils and commutator bars will increase the cost of the apparatus.

To overcome the commutating difficulties the designer so proportions his adjustable-speed motor that it will have a strong field and a comparatively weak armature. Too small an air-gap between the armature and pole faces will provide a path of low reluctance for the cross magnetism of the armature and will thus increase the armature reaction. Therefore, a *stiff* magnetic field is provided by using a large magnetizing force and a wide air-gap. The resistance property of the carbon brush is relied upon to a certain extent for communication, as it will permit of con-

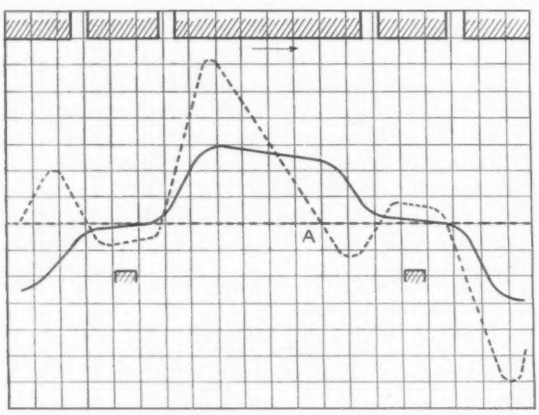


Fig. 15—Field Distribution Curves of 3-hp Standard Motor.

siderable variation in the commutating conditions. Other features of an adjustable-speed design for a standard type of motor are: Large frame to take care of the large total flux; large number of coils and few turns per coil in the armature to keep the self-induction per coil as low as possible; and a correspondingly large number of commutator bars. Motors thus designed will naturally be somewhat more expensive than motors of the same rating for constant-speed service.

High flux density at the pole tips tends to prevent distortion of the field and thus aids commutation. In the Storey motor, formerly manufactured by the Magneto Elec-

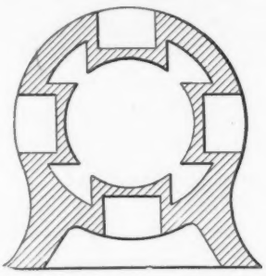


Fig. 16—Field Frame of Storey Motor.

tric Company, use was made of this device in combination with an armature winding of many sections. The flux was concentrated at the pole tips by making the pole cores hollow, as shown in Fig. 16.

The speed increase that can be obtained by field weakening from the standard shunt motor, not specially designed for adjustable speed, will probably average about 30 per cent, though some motors will not operate at this increase at full load without objectionable sparking. Evidently by reducing the current input of such a motor its speed range can be increased. An approximate idea of the ratings thus permitted can be had from Table V, although the exact rating permissible for a given motor depends upon the excellence of its design with regard to sparking and varies largely with different machines.

TABLE V.—RATINGS OF ADJUSTABLE-SPEED MOTORS.

Frame Size. Hp.	Hp Rating for Adjustable Speed.	
	2 : 1 Range.	3 : 1 Range.
3	2.0	1.5
10	7.5	5.0
15	10.0	7.5
20	15.0	10.0

In summing up this method of control it may be said that the single-voltage system with shunt-field controlled motors is almost the ideal of simplicity and efficiency and gives the best possible speed regulation. Where

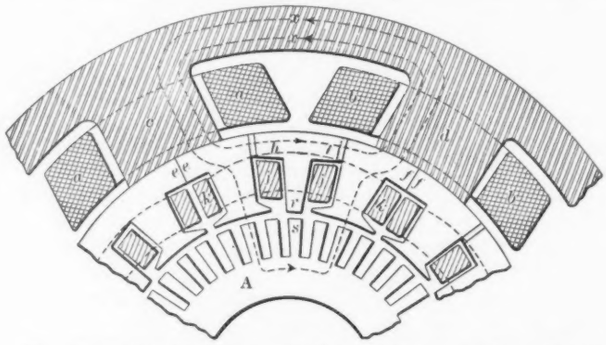


Fig. 17—Partial Transverse Section of Thompson-Ryan Motor.

the range of speed must be greater than can successfully be covered with the standard type of motor the difficulties may be overcome by compensated motors or motors of the "interpole" type, which will be hereafter described.

The Thompson-Ryan Compensated Motor.—The essential features of this adjustable-speed motor are outlined in Fig. 17.

Between the polar projections *c* and *d* there is a "balancing ring" made up of sheet-steel laminations, *h, i, r* and *ee, ff*. The last-named pieces constitute extensions of the polar cores. The portion of the ring opposite each interpolar space contains two coils. One coil *jj* embraces the small core *r*, while the other and larger coil *kk* embraces one of the *e* and one of the *f* cores. These coils are connected in series with the armature, so that the current they carry is always equal to that of the armature. The compensating coils *kk* are connected in such manner that the current in their conductors is opposite in direction to the current in the armature conductors lying directly under them. These equal and opposite currents neutralize each other, so that with proper proportioning the reaction of the armature upon the field may be entirely neutralized. Under these conditions the distribution of the field magnetism remains unchanged, no matter how weak the field may be or how strong the armature mmf.

The smaller coil *jj*, which is wound upon the core *r*, develops a magnetic flux which serves as the commutating field. This coil is in series with the armature and therefore the flux developed by it rises and falls with the rise and fall of the armature current, thus producing the condition that is needed for perfect commutation. It is in effect a commutating pole having precisely the same action as an "interpole," with the exception that in the present design the path of the commutating pole flux is through the "balancing ring" *h, i*, and not through the main yoke as in the interpole motor.

By the means described a suitably varying commutating field is not only provided but the armature reaction is also neutralized and the main field thereby maintained in its normal proportions under varying load and varying speed. In practice the degree of perfection depends upon the accuracy with which the electrical and magnetic parts are proportioned.

These motors are regularly manufactured in sizes from 0.75 hp to 50 hp and with adjustable-speed ranges of 6:1, 5:1, 4:1, 3:1 and 2:1. They are usually six-pole machines.

Interpole Motors.—In order to overcome the sparking difficulties inherent in the field-controlled motor of the standard type, adjustable-speed motors may be equipped with "commutating poles." This type of machine is in a

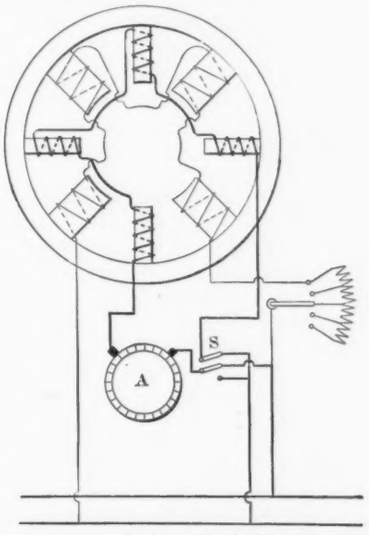


Fig. 18—Connections of Interpole Adjustable-Speed Motor.

general way an ordinary shunt motor with the addition of a small auxiliary pole midway between each pair of main poles. The function of the auxiliary poles is to produce and maintain a magnetic field, independent of the main field of the motor, suitable in strength and location for proper commutation under all conditions of load and speed. This means that the emf generated in a short-circuited armature coil by the interpole flux must be of just the proper value to arrest the current and reverse it in the coil while the terminals of the coil are passing under a brush —that is, it must just balance the reactive voltage of the coil. The reactive voltage ($2\pi fLI$) varies directly with the reactance and with the current in the coil. If the inductance L of the coil be regarded as constant[1] the re-

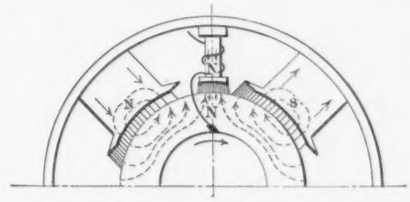


Fig. 19—Interpole Motor with Distorted Field.

actance will vary directly with the speed of the armature. Hence the reactive voltage varies directly with speed and armature current, and in order to counteract this voltage at all times the emf generated by the auxiliary pole must vary with the same factors. Since the emf generated by the field of the auxiliary pole varies directly with the speed and the flux density, it is evident that the desired result will be produced if flux density of the interpole be made to vary with the armature current. To meet this requirement the interpole windings are connected in series with the armature.[2] It has been found good practice to work the iron of the interpole at such a place on the magnetization curve that the saturation point will be reached with about twice the normal armature current. This load being well beyond the proper operating load of the motor, it is seen that through the normal working range the magnetization curve approximates a straight line closely enough for very satisfactory results. The resistance qualities of the carbon brush, as an aid to commutation, easily take care of any slight departure from the theoretically correct value of interpole flux.

The arrangement of poles and windings is shown in Fig. 18, in which the armature is shown removed from the motor and represented at *A*. The rotation is reversible by means of the reversing switch *S*, which merely reverses the armature current without affecting the direction of the main field current.

Since the interpole windings are connected permanently in series with the armature the reversal of rotation by

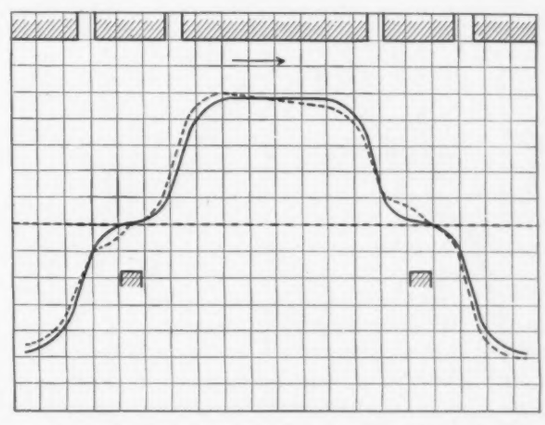


Fig. 20—Field-Distribution Curves of 5-hp Interpole Motor.

reversing the armature current also reverses the polarity of the interpoles, thus producing the required change in

[1]Inductance is not *strictly* constant with varying current, because of the effect of saturation in the iron.

[2]The interpole flux is not *strictly* proportional to armature current because of the effect of saturation, but it need not be strictly proportional because reactance of short-circuited coil is not strictly constant, as previously pointed out.

polarity of the commutating field without any change in the brush position.

It will be remembered that the field set up by the armature is opposite in direction to that desired for commutation, and to overcome this field and produce one in the right direction it is necessary for the interpole to be

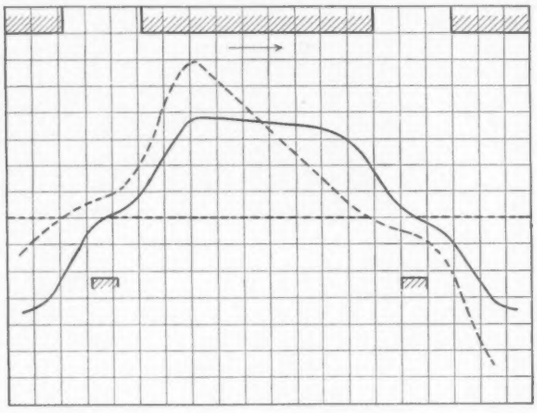


Fig. 21—Field-Distribution Curves of 5-hp Interpole Motor.

energized by a greater number of ampere-turns than the ampere-turns on the armature. Thus a certain number of the turns on the interpole may be regarded as serving only to balance the armature flux under whatever condition of load, and the surplus turns above that number are the ones which produce the resultant commutating field.

The result of the independent commutating field is a machine which can be operated as a motor or a generator for either direction of rotation without shifting the brushes or changing the connections. The brushes of the motor are set permanently in a central position, opposite the commutating poles. The interpoles do not prevent the distortion of the main field by armature reaction. The distortion takes place and becomes greater as the field is weakened to increase the speed, the same as in motors of standard construction, but this shifting of the field does not affect commutation, because the required commutating field

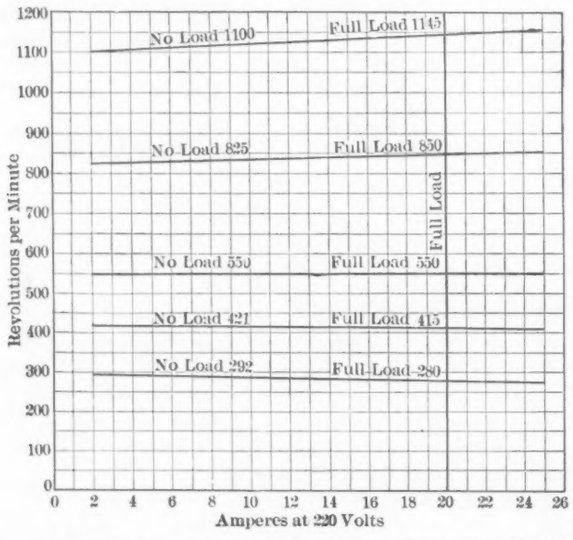


Fig. 22—Speed Curves Showing Regulation of Interpole Variable-Speed Motor.

is independently taken care of. A comparison of Figs. 19 and 14 will more clearly illustrate the action. In Fig. 19 the interpole flux is seen to be opposed to the armature flux.

Mr. C. H. Bedell in a paper before the American Institute of Electrical Engineers has presented curves showing the field distribution of a 5-hp interpole motor having a speed range of 275 r.p.m. to 1100 r.p.m.[1] The curves for minimum speed are shown in Fig. 20 and those for high speed in Fig. 21.[2] In each case the solid line is the no-load and the broken line the full-load curve. The slow-speed test shows very little armature reaction, but the test at high speed shows such excessive reaction under full-load conditions that the polarity of the weakened pole at the right-hand corner is not only neutralized but is actually reversed by a considerable amount. It will be noted, however (Fig. 21), that the curve is brought back to the proper polarity in the commutation zone by the action of the interpole.

It is stated in the paper referred to that the change in relative amounts of iron and copper in the armature made possible by interpole construction increases the efficiency on light loads while the full-load efficiency is not much altered, the result being a somewhat better "all-day" efficiency than that of standard-type motors.

A remarkable feature of this design is its peculiar speed regulation. If the brush is shifted away from the center of the interpole flux the latter has a slight compounding effect upon the motor. When the brush is shifted to one side this compounding is cumulative; when shifted to the other side the compounding is differential. For a given speed adjustment (that is, for a given strength of the shunt-field) it is possible to find a brush position which will insure practically constant speed at all loads. At higher speeds (weaker shunt-field) the differential effect is greater and the speed will decrease with increase of load. This characteristic is illustrated in Fig. 22, which shows a set of speed curves of a motor built by the Electro-Dynamic Company.

PRESSURE COEFFICIENTS OF ELECTRICAL RESISTANCE.

By A. A. Somerville.

IT is well known that the resistance offered to flow of current by a broken conductor is dependent upon the pressure holding the two parts of the conductor together. It is known as a contact resistance and as a mechanical connection. An electrical connection is a soldered, fused or electro-plated joint. In the case of a bright metal or clean surface of a material that is a good conductor the contact resistance is nil. If clean metal filings are put in a tube and loose connections made at either end, it is found that the resistance depends upon the pressure and is much greater than the resistance of a solid rod of the material in the tube. This knowledge is being made use of in the construction of two important pieces of apparatus, the telephone receiver and transmitter and the coherer in the wireless receiver.

The telephone is an adaptation from the microphone, an instrument which consists essentially of an arrangement by which one part of a circuit in which is included a telephone line and electric battery is completed by two conductors which rest lightly one on the other. Two pieces of carbon, one pointed and the other cup-shaped, make a connection that is very sensitive to change in pressure. In the telephone this variation in pressure is caused by the vibration of the diaphragm when the sound waves strike it.

A much more recent adaptation on somewhat the same order is the coherer. Here a tube of metallic filings is employed and instead of mechanical pressure being used to effect a change in resistance this apparatus is so sensitive that the presence of electro-magnetic waves is readily detected by the filings becoming a good conductor and

[1] *Trans.* A. I. E. E., Vol. XXV, p. 329, "Direct-Current Motor Design as Influenced by the Use of the Interpole."

[2] Fig. 21 has been slightly modified to embody results brought out by Mr. H. F. T. Erben in the discussion of Mr. Bedell's paper.

allowing current from a local battery to pass through the circuit of which it is a part. A mechanical tapping is then necessary to restore the filings to a condition of very high resistance again. Of course, the electro-magnetic waves do not produce pressure on the filings, but instead cause them to cling together in some way that is as effective as if mechanical pressure were applied.

Another use to which these powdered resistors may be put is in connection with heating units, and it has been suggested that they may be made to control automatically the maximum temperature at which they will operate by becoming practically current insulators at a quite definite point. The specific resistance may be controlled by proportioning the mixture of powdered material, the pressure which causes the change in resistance being due to the relative expansion of the powdered material and the tube containing it.

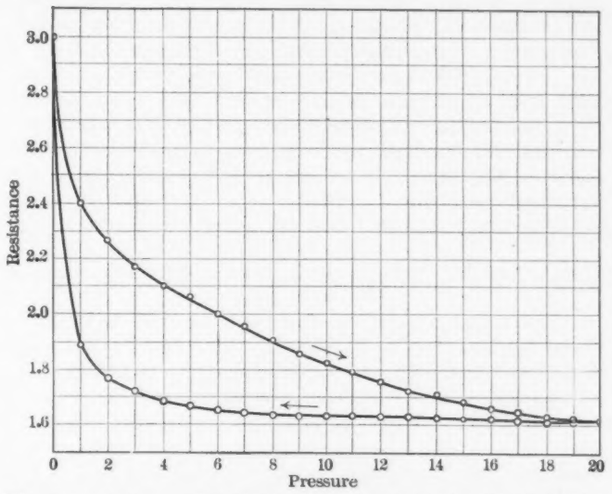


Fig. 1—Variation of Powdered Carbon with Mechanical Pressure.

The change of resistance of powdered carbon and of silicon with pressure change are two interesting and widely differing cases. By powdered material is here meant anything from the size of particles of sharp sand to the finest dust possible to make using a mortar and pestle. It was found that the variation in size within these limits does not affect the results here shown. The powdered material was put into a porcelain tube ⅓ sq. cm in cross-section and the two ends were equipped with closely fitting copper plugs. The distance between plugs was 5 cm and the pressure applied did not change this distance by any appreciable amount. Kilogram weights were added one at a time until a total of twenty was reached; as these were removed singly readings were taken of the resistance for all loads.

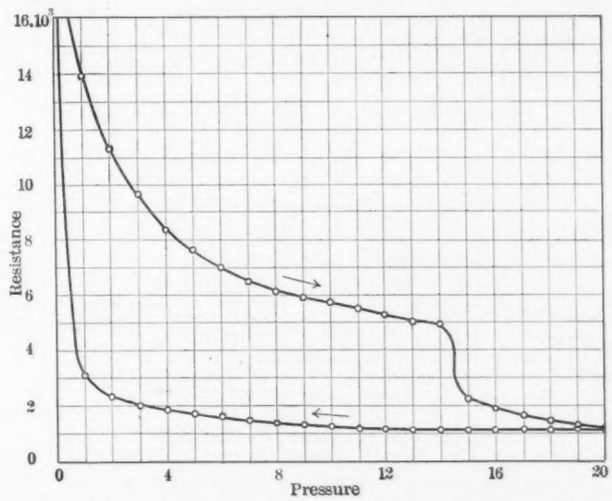


Fig. 2—Variation of Resistance of Powdered Silicon with Mechanical Pressure.

The resistance of such a tube of carbon measures 3 ohms at normal or atmospheric pressure. Adding pressure, the resistance decreases until at from 18 kg to 20 kg (40 lb. to 44 lb.) it becomes almost constant at nearly 1.6 ohms. Then as the pressure is removed the resistance does not increase so as to follow the same curve as before, but "lags behind," and when the pressure has been reduced to only 1.0 kg the resistance has increased only a small amount, but it resumes the original value when zero load is reached. The specific resistance of the powder at zero pressure is just fifty times as large as that of the carbon rod before it was pulverized. The maximum pressure used in the tests corresponded to 60 kg per sq. cm. (850 lb. per square inch).

Such a tube of powdered silicon has a resistance of 300,000 ohms at zero pressure. A pressure of 1 kg applied makes a resistance of 14,000 ohms. Up to a pressure of 14 kg a smooth curve is obtained, but when a small additional load is added there is a large decrease in resistance, represented as a break in the curve of Fig. 2. Decreasing pressure does not result in much change in resistance until all pressure is removed, when the original conditions are almost exactly obtained. The cycle may be repeated indefinitely without any further change.

The specific resistance of the silicon in this form is about 500,000 times as great at zero or atmospheric pressure as when it is in the form of a solid stick before being pulverized.

A PLOWED FIELD IS A 100,000-VOLT TRANSMISSION-LINE CONDUCTOR.

One of the No. 0 hemp-center stranded copper wires of the Central Colorado Power Company's 100,000-volt transmission line from its Boulder plant into Denver broke at the center of a 500-ft. span 2 miles from the city April 14, allowing the two ends to fall to the ground in a plowed field. It was then 1 a. m. and the system was carrying 3700 kw, but the ground connection thus established continued to carry the load without incident for seven hours. During this time one of the wires finally burned back to the point where it hung suspended from the tower insulator, thereby setting up a series of arcs between wire and ground and causing surges which attracted the attendants' notice by the swinging of the station-instrument needles. When the trouble was located, between the towers the No. 0 stranded conductor was found in the shape of a number of short sections averaging 6 in. in length, and below the end of each was a cone-shaped fulgurite in the clay soil, where the earthy matter had been fused to a mass of slag. As each section of conductor burned off the live end left had apparently established a new point of contact about 6 in. from the end, where it was in turn severed. Some of the fulgurites or slag masses measured 8 in. in diameter at the top, tapering to 2 in. at the tip 18 in. below the ground, and the surface of each was covered with numerous little spines or roots, apparently marking the points where the current entered the surrounding earth. In other places the fused mass lay in the direction of the line, and for several feet around this path the ground was too hot to stand upon, even three hours after the current had been shut off. Since the accident the field has been replowed, bringing to light numerous sections of the once molten, glassy path which joined the conductors. The cause of the span breaking in the center was traced to an unraveled strand in the ground wire which had dropped down on to the line conductor, thus burning the latter in two.

Central Station
Management, Policies and Commercial Methods

FARMER SERVICE NEAR FORT WAYNE, IND.

The Kehoe Light & Power Company, which purchases energy from the Fort Wayne & Northern Indiana Traction Company for distribution among rural communities in the vicinity of Fort Wayne, Ind., is developing a farmer business, served from its transmission lines. Farm customers are charged 10 cents per kw-hr. with an assured minimum annual payment of $24, payable monthly. The customer is required to purchase his own transformer, meter and all other equipment.

CENTRAL-STATION BUILDING AT LOWELL.

The Lowell (Mass.) Electric Light Corporation is planning to erect in the near future a general service building to serve as a stock-room, garage, motor shop and office for the engineering and distributing departments. The building will be located adjacent to the Perry Street plant in Lowell and will cost about $20,000. It is anticipated that the joining of the departments will facilitate the work and eliminate duplication, doing away with stock shortages and excessive storage cost by the present arrangement of scattered supply stations. The garage section will have a capacity of ten machines, and commercial electric trucks will be cared for until the company needs the space for its own vehicles. All subsidiary records will be maintained in the new building, but the commercial departments of the company will remain in the present offices.

FLAT-RATE CONTROLLER CAMPAIGN AT MARION.

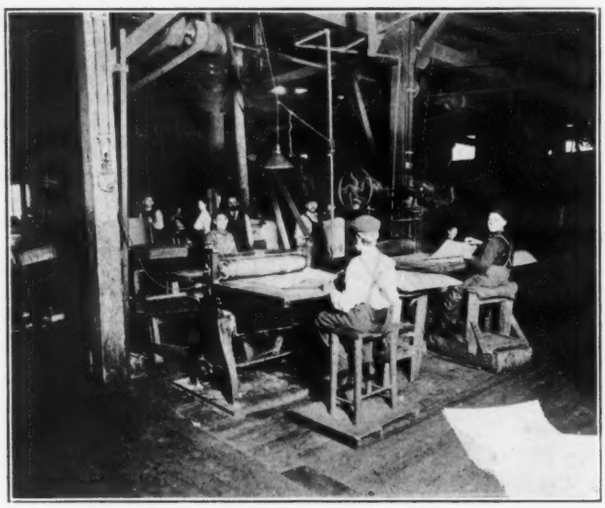
Since March 1 a flat-rate campaign to further the use of "Excess" indicators has been under way at Marion, Ind., and despite the fact that this city of 19,000 population has 3700 meters installed, twenty-three new flat-rate customers were secured in the first week, followed by forty others the second week. The rate made is 1.25 cents per month per watt connected, 20 per cent discount being allowed for prompt payment, giving a net rate of 1 per cent per watt. On its metered basis the alternative rate offered by the Marion company is 8 cents per kw-hr., with only 25 cents monthly minimum. The flat-rate schedule is thus based on four and a half hours' daily use of the connected load. By far the largest part of the flat-rate contracts closed have been for $1 per month, permitting the use of four 25-watt tungsten lamps. No provision is made for connecting up electric irons with the flat-rate installations, although about 2300 irons are in use by metered customers. Since the institution of the flat-rate campaign several new flat-rate customers have asked to be changed to a metered basis, while several former metered users have taken out flat-rate contracts.

LOUISVILLE NEW-BUSINESS METHODS.

In the solicitation of new business the Kentucky Electric Company, of Louisville, has found that specialization is highly advantageous. The company now employs twenty solicitors, fourteen of whom are under the direction of Mr. L. J. Hannah, head of the light installation department, while the remaining six work under the direction of Mr. W. D. Myers, who is in charge of new motor-service business. Prospective business of one kind or the other is referred to the appropriate department and handled by a man who has been studying that particular question, and in the case of projects where both features are to be handled the factor which is the more prominent determines the reference. The same plan is used in the motor-service department, being worked out still further. That is to say, the individual solicitors are trained so as to become specialists on certain lines of manufacture, such as woodworking, textiles, machine shops, etc. While every man is capable of handling anything of a general nature which comes along, the idea is to make him an expert in some particular branch.

HEATING OF ROLLS FOR PARAFFINING PAPER.

Steam was formerly used to heat the rolls in the cardboard-sliming plant of Reynolds & Reynolds, Dayton, Ohio. The paraffine is applied to the paper by passing the sheets between pairs of rolls the upper one of which is heated while the lower revolves in a bath of melted paraffine carrying the oil to the hot paper. At the time the factory was being electrified with motor drive throughout it was decided to replace the steam pipes with electric heat. Accordingly heating units were improvised for the rolls, each of which consumes 1800 watts and averages ten to twelve hours' use daily. At the manufacturer's rate for power, the cost of this heating service is about 3 cents per kw-hr., and the operation of the two machines has amounted to about the same as the former cost of steam heat.



Electrically Heated Rolls for Paraffining Paper.

COMPETITIVE ILLUMINANTS.

At a recent meeting of the New England Section of the Illuminating Engineering Society Mr. Norman Macbeth, Pittsburgh, Pa., read a paper entitled "Competitive Illuminants from the Standpoint of the Salesman," in which was emphasized the importance of assuming a high ethical standpoint in marketing appliances. He stated that generally the gas men have a more inflated idea of the good points in electricity than of the bad features of gas service. Many installations are changed back and forth from gas to electricity because the merchants simply desire to alter

the appearance of their premises. Mr. Macbeth contended that the best way for the central station to push lighting is to take care of its present installations and see to it that the customer gets as much as possible for his money. He deprecated selling the consumer equipment unsuited to his needs and urged that tactful advice be given by salesmen in cases where poor selections are sought. He felt that illumination is sold at too low prices to-day in comparison with the cost of many other utilities. Regarding new installations of electric lighting in large residences designed by eminent architects, Mr. Macbeth said that too much is expected of the latter in view of the low cost of lighting equipment in relation to the total expense of the building. A field exists for the sale of electric appliances on a rental basis, setting payments aside on the instalment plan until the installation cost is covered. Trial installations are also beneficial in many cases. It pays to retain tungsten lamps in service down to 65 per cent of their initial candle-power.

OPERATING COSTS OF DIESEL ENGINE PLANTS.

Eighteen months ago a certain 500-hp oil-burning steam plant in a Southwestern town was converted to Diesel-engine drive. Careful records have been kept of this station during both steam and internal-combustion operation, and accurate analyses have been made of the items entering into the cost. Following are the figures, taken from the company's records, of a given month's operation in 1910 and in 1911, one representing all-steam and the other all-Diesel operation:

	Steam.	Diesel.
Kilowatt hours produced	38,402	63,780
Kilowatt hours per pound fuel oil	0.205	1.280
Kilowatt hours per gallon fuel	1.54	9.49
Total manufacturing cost	$884.86	$646.08
Operating cost	844.24	530.69
Maintenance cost	40.62	115.39
Power plant wages	210.00	251.70
Fuel for power	540.00	179.34
Water for power	65.00	32.50
Miscellaneous operating expense	16.95	25.12
Maintenance:		
Boilers	$60.85	.....
Engines	10.65	$95.67
Electric plant	8.85	10.97
Miscellaneous	12.75	8.75
Buildings	7.52	.....

In the plant just alluded to the load increased so rapidly that a third 250-hp engine was added shortly after starting up and now a fourth unit is about to be put into service. In another Southwestern station, where two 250-hp Diesel sets have been in service six years, a third is to be added

COST OF CENTRAL STATION IN 1911.

Expenditures.	Amount.
Cost of manufacture	$7946.14
Operating cost	6867.97
Wages	3032.30
Fuel	3227.44
Water for power	50.53
Lubrication	530.88
Miscellaneous	26.82
Maintenance:	
Engines	1030.87
Miscellaneous station equipment	56.58
Buildings and fixtures	144.77

to take care of the growth of the business. Herewith is given a detailed statement of the cost of running this plant during 1911, its sixth year of service, for the first pair of engines. A total of 1,080,088 kw-hr. was produced in the twelve months at a total cost of manufacture of $0.0072 per kw-hr., of which $0.0063 is due to operating cost alone.

RELATION BETWEEN THE COMPANY AND THE PUBLIC.

At a meeting of the commercial division of the Commonwealth Edison Company Section of the National Electric Light Association in Chicago last month Mr. John W. Ferguson, assistant to the general contract agent of the company, read a pithy paper on "The Relation Between the Company and the Public"—a subject to which he has paid much attention. The speaker pointed out that business is not a "machine"; the machinery of business must be vitalized if it is to be successful. Continued prosperity must depend largely upon the quality of pleasing which must emanate from the establishment. Every concern is as big as the head of that concern, and the same remark applies to the heads of departments. The public-utility company has duties as well as rights, and the duties to the public must be drilled into employees by a never-ceasing process of education as new blood is brought into the organization.

It should be the duty of every employee to see that the agreement with the customer is carried out thoroughly. Mr. Ferguson dwelt especially on the need of inter-departmental courtesy, and pointed out that very frequently complaints have to do with several departments in a big organization, and that if these departments show courtesy to one another the customer will be impressed and will believe that the same courtesy is intended to be shown to the general public.

What is called "red tape" is necessary for the proper handling of the work in any department of a large industry, notwithstanding the opprobrium which is generally attached to this much-abused expression. Every man performing his duty properly is part and parcel of the "red tape." Inasmuch as this is true, employees before criticising the system should be sure that their own record is clear.

The speaker expressed himself as in favor of the state supervision of public-service companies, and said that he hoped the time was not far distant when Illinois would have a state commission for this purpose. He said that the company and its employees should show by their acts a realization of the fact that their privileges have been granted by the people, who have the right to demand an account of the stewardship. In this way criticism will be disarmed.

One thing Mr. Ferguson insists upon is courtesy over the telephone. He declared that the misuse or careless use of this great modern convenience on the part of employees of public-service companies has caused much of the ill feeling toward these corporations. One should school one's self to be patient, polite and exact over the telephone. The speaker illustrated his remarks with anecdotes, and emphasized in his speech, as he does in his daily life, that the public should at all times be accorded that courteous though not subservient treatment which should be expected from a gentleman.

Mr. Louis A. Ferguson, vice-president of the company, in the discussion emphasized the fact that merchandising is not nowadays so much a matter of price as of service. The service comes from the employees, the men who handle the goods. It depends on personality, and the man who develops his personality most is the man who does more than is allotted to him. The speaker also dwelt on the great necessity of accuracy, which he said is very important in all departments of the company's business and in its relation with the public. At heart the public is right and is not really antagonistic to corporations. Several others discussed the paper, including Mr. Peter Junkersfeld and Mr. M. L. Eastman. The latter dwelt on the need of reciprocity between the company and its customers. Every man in the company, he said, should become a solicitor of friendship for the company. In closing the discussion, Mr. John W. Ferguson alluded again to the great importance of loyalty to the company.

MEAT SAVED PAYS COST OF ELECTRIC COOKING.

That in a 9-lb. leg of mutton as much as 1½ lb. of meat may be saved by cooking in an electric oven, compared with cooking the same joint by gas or coal, was pointed out by Mr. J. D. A. Cross, Chicago, not long ago.

A number of careful and independent experiments in England, said Mr. Cross, have shown that there is a shrinkage of from 25 to 35 per cent in the weight of meat cooked by coal or gas, whereas the same kind of food cooked to the same degree by electricity loses only 10 or 15 per cent of its original weight. Thus it is conceivable that even if coal or gas cost nothing it would be cheaper to use an electric oven, since the loss due to electric cooking is so slight compared with that sustained when gas and coal ovens are employed.

TABLE I.—RESULTS FROM ELECTRICAL COOKING.

Joint.	Weight Before Cooking. Lb.	Oz.	Weight After Cooking. Lb.	Oz.	Type of Oven.	Loss of Weight. Lb.	Oz.	Loss per Cent.
Ribs of beef	5	7	3	12	Coal	1	11	31.0
Leg of mutton	8	8	5	13	Coal	2	11	31.7
Shoulder of mutton	6	13	5	1	Coal	1	12	25.7
Leg of mutton	8	4	6	0	Gas	2	4	28.1
Leg of mutton	8	0	7	12	Electricity	1	4	13.1
Shoulder of mutton	4	12	4	2	Electricity	0	10	13.1
Ribs of beef	9	1	7	6	Electricity	1	11	18.6
Leg of mutton	9	1	7	10	Electricity	1	7	15.8
Shoulder of mutton	5	10	5	0	Electricity	0	10	11.1

TABLE II.—COOKING BEEF BY ELECTRICITY, COAL AND GAS.

Weight of Cooked Joint.	Weight to Be Ordered from Butchers When Cooking Is to be Done by					Saving of Meat and Money When Electricity Is Used Instead of				
	Electricity.		Coal.		Gas.	Coal.			Gas.	
Lb.	Lb.	Oz.	Lb.	Oz.	Lb. Oz.	Lb.	Oz.	Value.	Lb. Oz.	Value.
4	4	8	5	11	5 14	1	3	$0.28	1 6	$0.32
5	5	11	7	3	7 6	1	8	0.36	1 11	0.40
6	6	13	8	9	8 13	1	12	0.42	2 0	0.46
7	7	9	10	0	10 5	2	1	0.50	2 6	0.56
8	9	2	11	7	11 13	2	5	0.56	2 11	0.64
9	10	4	12	4	13 4	2	10	0.62	3 0	0.72
10	11	6	14	5	14 11	2	15	0.70	3 5	0.80
11	12	8	15	11	16 3	3	3	0.76	3 11	0.88
12	13	10	17	2	17 11	3	8	0.84	4 1	0.98

TABLE III.—COOKING MUTTON BY ELECTRICITY, COAL AND GAS.

Weight of Cooked Joint.	Weight to Be Ordered from Butchers When Cooking Is to be Done by					Saving of Meat and Money When Electricity Is Used Instead of				
	Electricity.		Coal.		Gas.	Coal.			Gas.	
Lb.	Lb.	Oz.	Lb.	Oz.	Lb. Oz.	Lb.	Oz.	Value.	Lb. Oz.	Value.
4	4	8	5	7	5 8	0	15	$0.20	1 0	$0.20
5	5	11	6	13	6 15	1	2	0.24	1 4	0.25
6	6	13	8	2	3 5	1	5	0.26	1 8	0.30
7	7	15	9	7	9 11	1	8	0.30	1 12	0.36
8	9	2	10	13	11 2	1	11	0.34	2 0	0.40
9	10	4	12	2	12 8	1	14	0.38	2 4	0.46
10	11	6	13	8	13 15	2	2	0.42	2 9	0.52
11	12	8	14	14	15 5	2	6	0.48	2 13	0.56
12	13	10	15	4	16 11	2	10	0.54	3 1	0.62

Table I, prepared by Mr. K. B. Matthews, an English electric heating engineer, shows a compilation of a number of experiments made with various kinds of heat for cooking.

Tables II and III show the relative quantities of meat to be purchased in order to serve a given amount when the cooking is done with electricity, coal and gas respectively.

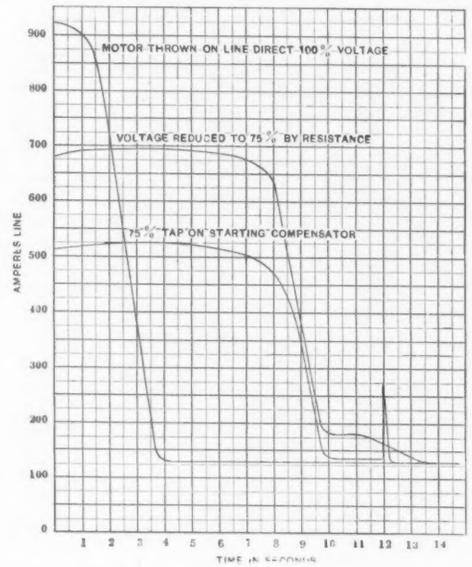
Wiring and Illumination

INDUCTION MOTOR WIRING.

By H. B. Foote.

With the increased application of induction motors to industrial machine drive it seems desirable to develop a wiring table which can be used by the electrical contractor or motor-service solicitor to enable him to figure the installation cost with the average length of run encountered in this class of work. The author in the present article deals only with the squirrel-cage type of motor and assumes the prevailing practice of using a starting device for motors above 5 hp in rating.

The National Electrical Code rules applying to this class of wiring do not cover the subject as thoroughly as they do direct-current wiring, the reason being that the latter has been in use for many years and that each successive issue of the code is merely a revision of the previous one. The two rules which govern the size of wire to be used are as follows: Rule 23*e*—"Where rubber-covered wire is used for the leads or branches of alternating-current motors of the types requiring large starting currents the wires may be protected in accordance with Table B of No. 18." Rule 68*h*—"Fuses must be so constructed that with the surrounding atmosphere at a temperature of 75 deg. Fahr. (24 deg. C.) they will carry indefinitely a current 10 per cent greater than that at which they are rated, and at a current 25 per cent greater than the rating they will open the circuit without reaching a temperature which will injure the fuse tube or terminals of the fuse block. With a current 50 per cent greater than the rating and at room temperature of 75 deg. Fahr. (24 deg. C.) the fuses starting cold must blow within the time specified as follows: 0-30 amp, one minute; 31-60 amp, two minutes; 61-100 amp, 4 minutes; 101-200 amp, six minutes; 201-400 amp, twelve minutes; 401-600 amp, fifteen minutes.



Starting Currents at Full Load for a 100-hp, 440-Volt Motor.

An induction motor designed to meet the best condition of normal operation should have as low an impedance as practicable, but a motor of this description necessarily takes a very large current in starting, this current being inversely proportional to the impedance. This starting current, therefore, varies with the load. The average condition met with in practice and considered in these tables is 100 per cent load. Under these conditions the starting current will be about four times normal current when a starting com-

pensator is used and very close to five times normal current when the motor is thrown directly on the line.

The accompanying illustration shows curves for a 100-hp, 440-volt motor, started with 100 per cent load by means of a starting compensator, a starting resistance and by throwing directly on the line. These curves show that this starting current does not last over ten seconds.

It will be found by computing the size of wire for any ordinary length of run that the starting fuses necessitate a larger wire to be used than would be required to carry the full running current of the motor. This is still the case when advantage is taken of Rule 23*e*, which allows rubber-covered wire to be fused to the carrying capacity given in Table B. However, further advantage may be taken of

SIZE OF WIRE AND FUSES FOR THREE-PHASE, 220-VOLT AND 440-VOLT MOTORS.

Horse-Power.	220-volt.			
	Full-load Amps.	Starting Fuses.	Wire Size, Rubber-covered.	Wire Size, Weatherproof.
1	3	10	14	14
2	6	20	12	12
3	9	30	10	12
4	11	40	8	10
5	14	50	8	10
7½	20	60	6	8
10	27	75	4	8
12½	33	90	4	6
15	40	100	3	6
20	50	140	2	4
25	63	175	0	2
30	75	200	0	2
35	89	250	00	1
40	100	275	000	0
50	125	350	0000	00
75	185	500	400,000	0000
100	250	650	600,000	400,000
150	370	1000	1,000,000	600,000

Horse-Power.	440 volt.			
	Full-load Amps.	Starting Fuses.	Wire Size, Rubber-covered.	Wire Size, Weatherproof.
1	1.5	5	14	14
2	3	10	14	14
3	4.5	15	12	12
4	5.5	20	12	12
5	7	25	10	12
7½	10	30	10	12
10	14	40	8	10
12½	17	45	8	10
15	20	50	6	8
20	25	70	6	8
25	32	90	4	6
30	38	100	3	6
35	45	125	2	4
40	50	150	1	4
50	63	175	0	2
75	93	250	00	1
100	125	325	0000	00
150	185	500	400,000	0000

Rule 68*h* because it will be found, by reference to the starting curves, that the fuses will carry 50 per cent over their normal rated capacity for a greater length of time than the duration of the starting current. From the foregoing it will be seen that the size of wire for any induction motor may be computed by making the line fuse equal to two-thirds of the starting current and selecting a size of wire having the nearest current value to the fuse, using the carrying capacity given in Table B of the National Electrical Code.

There seems to be no rule regarding the fusing of weatherproof wire which makes any concession for this class of work, but, owing to the fact that it is never installed in conduit and therefore has a greater radiation, it should be permissible to make the same reduction from Table B as is made between Tables A and B.

The accompanying tables have been computed for 220-volt and 440-volt motors on the above basis. The maximum distance from starting fuses to motor in industrial plants is seldom more than 100 ft. For this distance the size of rubber-covered wire given in the table will not produce more than 1 per cent total voltage drop, with 25 per cent overload on the motor. Here again is brought out the fact that for lengths of run up to 500 ft. the starting fuses determine the size of wire required if the National Electrical Code rules are adhered to. If fuses were built to stand a higher momentary overload, the amount of copper necessary for this class of wiring would be reduced. However, in the smaller sizes of motors it is well to have the wire of ample size because it is very often the case that the motor is operated below its full rated load, producing a low power-factor and thereby increasing the current. On the other hand, when installing motors of 100 hp and over it is well to inquire into the starting conditions because a reduction in the size of starting fuses will mean a considerable saving in copper.

A considerable reduction in the cost of wiring can be made, where the starting switches are not too widely separated, by placing the meter on the primaries of the transformers and running a set of starting leads to the switches. This requires but one set of starting fuses and leads large enough to carry the starting current of the largest motor, if but one motor be started at a time.

DISPLAY AND INDIRECT LIGHTING.

Mr. F. L. Godinez, of New York, gave an illustrated talk upon artificial lighting before the New England Section of the N. E. L. A. at Boston on May 3, about 200 being present. He pointed out that increased revenue and expansion in public utilities depend upon the continued satisfaction of the consumer, and he emphasized the desirability of more severe tests of appliances by operating companies, which are regarded by the public at large as responsible for the success or failure of all sorts of apparatus in service.

Taking up illuminating engineering, the speaker said that too often the public looks upon the specialist in this field as a cross between the lamp salesman and the reflector vender. He criticised the attitude of utility companies which has led the public in certain places to feel that one cannot enter the central-station office without being asked to purchase illuminating equipment. The advertising value of new forms of illumination was brought out and Mr. Godinez vigorously opposed arguing with the consumer on the grounds of economy. He felt that in window lighting the treatment of the window is the vital point. It is helpful to look at the display window as a miniature stage which in a merely nominal space of time must attract the attention of the passer-by. The advertising value of concealed window lighting is very great. Such installations tend to draw people into mercantile houses out of curiosity on account of the age-long necessity of looking at exposed lamps in windows. It is well to avoid polished interior surfaces in shade designing, these acting as distraction factors in their influence upon the public.

Mr. Godinez pointed out that one of the chief reasons for the success of indirect lighting was its difference from other kinds of illumination. Originality in lighting is a vital feature of anything beyond ordinary success. Good illumination involves a study of physiological and psychological conditions, architecture and many other subjects. The value of yellow-tinted lamps in reducing eye strain was emphasized and the restfulness of amber light in the home was touched upon. The speaker referred again to the benefits of dull reflecting surfaces and presented diagrams of flux distribution showing the effects of placing lamps in the wrong types of holders. Much trouble in distribution arose

from the use of the drawn-wire tungsten filament, nearly all the manufacturers having failed to allow for the distortion due to changes in loop location within the lamp bulbs. The difference of a single foot in height in connection with a large fixture for church lighting on the indirect system is not infrequently sufficient to spoil the illumination as a whole. Indirect lighting offers the central station a highly satisfactory revenue on account of the number and size of units required. The number of auxiliary appliances is reduced, tending to decrease the wiring investment, and shadows can be better controlled.

DO LAMPS "OVERSHOOT" IN CANDLE-POWER?

By Evan J. Edwards.

The question of so-called "overshooting of candle-power" has been the subject of much discussion since the advent of the metal-filament lamp. Many writers refer to this phenomenon as one which, without question, exists; others have expressed a doubt as to its existence, and a few have argued that no such thing as overshooting of candle-power can take place. The fact that the question has little bearing on the practical operation of lamps probably accounts for its being unsettled to-day.

Theoretically there can be no overshooting of temperature when the voltage across the lamp is maintained constant, provided the resistance changes are coincident with changes in temperature. Resistance measurements made by Mr. Conner and the writer, reported in the *Electrical World*, Aug. 19, 1911, indicate that these changes are coincident; at least there is no indication that they are not, even under the rapid changes of a 60-cycle circuit. Since the phenomenon of overshooting, as reported, involved a time element of a much greater magnitude than one cycle on 60-cycle power, it is obvious that overshooting cannot be explained on the grounds of a lag of resistance behind temperature.

Proving that a lamp which has a constant potential applied across its terminals does not overshoot, of course, does not prove that there can be no condition in a supply circuit which will bring about an initial excess temperature. But there is plenty of evidence to show that the phenomenon which has been called overshooting as applied to intensity is in most cases an illusion. In the first place, a lamp which is placed on a special circuit, the voltage of which is known to remain strictly constant, appears to overshoot in intensity exactly the same as it does on the ordinary circuit. Again, a carbon lamp which is forced to flash up to full brilliancy quickly by impressing a high voltage seems to overshoot its normal intensity the same as do the metal lamps at normal voltage. Also, a metal-filament lamp with the voltage reduced to the point which will give the same interval of time to come to final brilliancy as the carbon lamp at normal voltage gives no appearance of overshooting. Even a constant light source when very quickly uncovered before a dark adapted eye, seems to flash above its subsequent value.

The time from closing the circuit till the filament reaches full brilliancy is essentially the same for all sizes of filaments of a given material with a voltage which will result in the same final temperature. This fact may be very easily demonstrated by connecting a number of lamps of various sizes, and all of the same rated voltage, in parallel and flashing them on and off. The interval of time between closing the circuit and final brilliancy may be varied at will by changing the impressed voltage. When the interval is made less than a critical value of something like 0.2 second the intensity seems to "overshoot" regardless of the filament material, resistance characteristic, condition of the vacuum, or in fact anything else except those things which affect vision, such as previous adaptation, contrast with surrounding objects, etc. Impressing double voltage on a carbon lamp is a simple and convincing experiment to show that the appearance of so-called "overshooting of candle-power" is not confined to metal lamps having low cold resistance.

The writer some time ago made photographic observations on various sizes of tungsten-filament lamps with various circuit conditions and found no evidence that the luminous intensity overshot its normal value. He found later that Mr. M. Luckiesh, a recent contributor to the *Electrical World*, had made a similar investigation (not published, but referred to by permission). Mr. Luckiesh's experiments also forced the conclusion that the luminous intensity approaches its final value without exceeding it.

The writer cannot but believe that the published experimental results which show overshooting represent some extraordinary conditions rather than the usual.

RECENT TELEPHONE PATENTS.

SWITCHBOARD CIRCUIT SYSTEM.

A patent has been granted to Mr. H. G. Webster, of Chicago, for a two-wire multiple common-battery system. In this system the line relay is differentially wound as shown in Fig. 1. When a call is originated by closing the circuit of the line, current flows through a circuit, including one winding of the line relay, from the battery and ground connections at the lower end of the cut-off relay. The line relay responds and lights the line lamp. When an operator

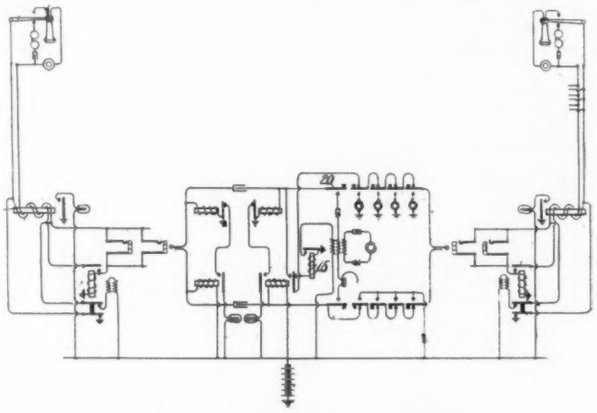


Fig. 1—Telephone-Exchange System.

responds by plugging in with the left-hand or answering plug, the cut-off relay operates, thus locking itself through its upper contact. The battery for this and for the line is supplied through the cord supervisory control relay. The line circuit is completed through the grounded relay of the cord circuit. The differential action releases the line relay. On the calling cord during ringing the cut-off relay is maintained by an auxiliary battery connection made through an inner contact of the ringing key. This patent has been assigned to the Kellogg Switchboard & Supply Company.

NEW DESK SETS.

Mr. C. C. Blackham, of Bridgeport, Conn., has patented a new form of desk stand. The usual base and vertical body tube are provided, but the tube is capped. There is mounted in this tube a horizontal journal in which turns a pin which carries a specially shaped bracket to which are secured both transmitter and receiver. The bracket takes the form of the letter "J," the receiver being mounted at the top and the transmitter on the curved end. The arm is so attached to the pin that the transmitter end is heavier. A cam is secured to the pin so that when the bracket is moved from the vertical position to one approaching 45 deg., which corresponds to a convenient angle for the transmitter

and a proper position of transmitter mouthpiece and receiver for use, the talking connections will have been established by the action of the cam upon the switch springs.

The desk set invented by Mr. R. A. Boniventure, of New York City, also has a special bracket, but in this case the bracket carries the receiver only, the transmitter being mounted as usual at the top of the upright. An auxiliary upright is so mounted that it will pass between the prongs of the switch hook.

This upright is clamped in a stationary position, but it carries within a second upright which is surmounted by a clamp, to which the horizontal receiver arm is connected. The arm, clamp and auxiliary upright can turn together about a vertical axis. Secured to the auxiliary upright is a stud which projects through a slot in the stationary upright at the height of the hook switch lever. When the horizontal receiver arm is parallel to the face of the transmitter the hook switch is driven down, as this is the position of non-use. When the receiver arm is pulled around to a position of approximately right angles to the face of the transmitter so that the receiver will be presented to the ear at the same time that the lips approach the transmitter the projecting stud travels upward in its slot, permitting the hook switch to rise.

IMPROVED RECEIVER.

It has been for many years the general practice to make the casing of telephone receivers of hard rubber or of some composition of similar mechanical and insulating properties. There has, however, been developed recently a metal-shell receiver, the parts of the shell being formed out of sheet metal. It is with such a receiver that a patent recently issued to Mr. W. W. Dean, of Elyria, Ohio, is concerned. This patent specifically covers the insertion of auxiliary metal rings at the point where the cap and shell screw together. The rings are properly threaded so as to engage, the threads of the one being internal and of the other external. The internally threaded ring is arranged to slip within the flange of the cap piece, the edge of the flange then being spun over to secure the ring. Similarly the end of the shell is reduced in size so as to slip within the externally threaded ring and the projecting edge of the shell is then spun over outward to secure this ring. This patent is assigned to the Dean Electric Company.

TRANSMITTER.

A patent granted to Mr. M. Moloney, of Christchurch, New Zealand, describes a special form of transmitter. This is shown in section in Fig. 2. It will be noted that the main granule chamber lies immediately behind the diaphragm. This chamber is formed by the diaphragm, a carbon ring of special section which forms the body walls and a rear

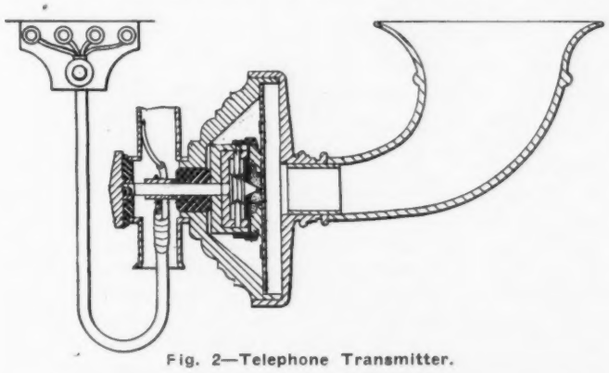


Fig. 2—Telephone Transmitter.

carbon washer with a central perforation. The body ring and the carbon washers are secured to a metal support by means of the insulating clamping ring shown, and insulation is inserted between the carbon washer and the metal support. The metal support is cup-shaped and has a cup-shaped carbon liner which in turn supports numerous radial inwardly projecting carbon pencils which are similarly pointed. These points lie on a circle so that they may form a common support for the grooved carbon stud as shown in the figure. The rear end of this carbon stud attaches to a conducting supporting rod while the front face is extended to form a cone as indicated. Upon this cone, against the face of the stud, is mounted a carbon washer which just fits the bore of the cup liner, while the stud itself just fits the perforation of the washer which forms the rear wall of the granule compartment. These fits are so arranged that space is left between these washers, which is filled with carbon granules. The space about the point of the stud in the granule compartment is also filled with carbon granules. The point of the stud just clears the diaphragm. The shell of the transmitter forms one battery pole and the current has several paths, one from the diaphragm through the main body of granules to the point of the stud, one through the granules to the rear washer, thence to the cup liner and metal cup. Again a side path is furnished from the body of the stud to the pencils and thence to the cup. There is again the direct connection from the stud to its conducting support.

METERING SYSTEM.

A patent granted to Mr. G. Grabe, of Nikolassee, Germany, and assigned to the Siemens-Halske company, describes a metering system for counting completed connections with an automatic system. The principal object is to arrange the apparatus so that the completion of a call as evidenced will cause the meter to operate before the disconnection apparatus. The system is worked out for a particular type of apparatus and involves auxiliary relays for controlling the registering of the meter and the following restoration of the selectors.

CALLING SYSTEM.

It is sometimes desirable to arrange party lines so that stations may signal each other without signaling the central operator and vice versa. Such is the system patented by Mr. H. F. Joeckel, of Camp Point, Ill. The central office drop is operated by current over a complete metallic circuit, while the subscribers' stations are signaled over a grounded circuit. A key at each station serves to connect the hand generator to either the metallic or grounded circuit as desired.

Letters to the Editors

HIGH-SPEED, UNIFLOW STEAM ENGINE.

To the Editors of Electrical World:

SIRS:—It is only fair to all your readers to say to them that the high-speed, uniflow steam engine built by Messrs. Browett, Lindley & Company and described in your issue of April 13 is covered by and manufactured under no less than thirteen of my patents. I should be glad if you would publish a note to this effect.

Manchester, England JOHN DAVIDSON.

WIRELESS-TELEGRAPHY STANDARDIZATION.

To the Editors of Electrical World:

SIRS:—Referring to the editorial in your issue of May 4 on wireless-telegraphy standardization, may I take an exception to the statement that transmitting outfits are rated in power input? The Telefunken Company, including the American company, has been rating its tests for some time in terms of power delivered into the antennas, which rating is guaranteed for a prescribed form of antennas.

New York. W. V. HENSGEN.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Standardization Rules.—A complete set of illustrated standardization rules for dynamo-electric machines and transformers which are to be discussed and voted upon at the next general convention of the German Association of Electrical Engineers, which is to be held in Leipzig from June 4 to 8. Definitions are first given. "Wechselstrom" comprises both single-phase current and polyphase currents; "Drehstrom" is interlinked three-phase current. Rules are given on the statements to be printed on the name plates of the machines, together with regulations as to commutation, temperature increase, overload, insulation, efficiency, and voltage variations. For new installations and for price lists it is recommended that the following values of frequency, speed and voltage should be chiefly considered. The frequency should be fifty. The speed should be arranged according to the following table:

	NUMBER OF POLES FOR ALTERNATING CURRENT.																	
	2	4	6	8	10	12	16	20	24	28	32	36	40	48	56	64	72	80
Number of revolutions of generators, synchronous motors, unloaded induction motors or direct-current motors	3000	1500	1000	750	600	500	375	300	250	214	188	166	150	125	107	94	83	75

The voltage of direct-current motors should be 110 or 220 or 440 or 500 or 750 volts. The voltage of single-phase and polyphase motors and the primary voltage of transformers should be 120 or 220 or 380 or 500 or 1000 or 2000 or 3000 or 5000 or 6000 volts.—*Elek. Zeit.*, May 2, 1912.

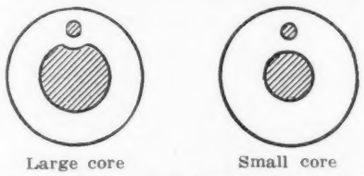
Motor Design.—K. Pichelmayer.—A review of the great changes which have come about during the last ten years in the design of dynamo-electric machinery on account of the greatly increased speed, especially since the introduction of the steam turbine, and on account of the greatly increased output rating of single machines. These developments have necessitated the use of commutation poles on direct-current machines. In the competition between different types of single-phase alternating-current motors the series motor has proved superior to the repulsion motor, especially for large outputs. The use of induction motors has increased enormously, and a satisfactory method of speed regulation of large induction motors has been found in their concatenation with small commutator motors.—*Zeit. d. Oester. Ing. u. Arch. Ver.*, Feb. 9, 1912; abstracted in *La Lumière Elec.*, May 4, 1912.

Heating of Electric Machines.—F. Niethammer.—A mathematical article giving formulas for the heat conductance in electric machines and the losses of heat to the outside, together with numerical values of the coefficients which occur in these formulas.—*Elek. Kraft. u. Bahnen*, March 4, 1912.

Collecting Current.—J. E. Noeggerath.—An illustrated article on methods of collecting current with special reference to high-speed unipolar machines.—*Elek. Kraftbet. u. Bahnen*, Feb. 14 and 24, 1912.

Lamps and Lighting.

Yellow Flame Arc Lamps.—M. Solomon.—An illustrated paper presented before the Birmingham Section of the (British) Institution of Electrical Engineers. The flame-arc lamp electrodes originally patented by Bremer were solid in form, being made from a homogeneous mixture of carbon and coloring material. The standard flame electrode in use to-day is simply a carbon cylinder having a core of special composition. Nearly all manufacturers make the shells of their flame carbons from a high-grade "soot" mixture. The differences, therefore, lie in the composition of the core and the mechanical design of the electrode. By design is meant the ratio between the diameters of the electrode and the core and the diameter of the electrode intended for a certain current, etc. The diameter of the core in an electrode used as a positive in a direct-current lamp is considerably larger than that of an electrode used as a negative. Standard flame electrodes may be divided into two classes, namely, large-core flame electrodes and small-core flame electrodes. The diameter of the core in the large-core electrodes is one-half the outer diameter of the electrode; its area is, therefore, one-quarter of the total area. In the small-core electrode the core diameter is one-third and the area of the core one-ninth. In order to reduce the resistance of long electrodes they are either copper plated on the surface or receive a special metal core. The latter method is now becoming universal, the increased conductivity being obtained by threading a brass or zinc wire the length of the electrode and turning its upper end down the side of the electrode, so that there may be direct electrical contact between the lamp-holder and the wire. The wire is run in a separate channel. Fig. 1 shows on an enlarged scale the cross-section of a large-cored and a small-cored electrode provided with this separate channel, and it will easily be realized that the formation of this small hole increases the cost of tools and the difficulty of pressing the electrodes, and thus raises their cost. The advantages gained are, however, considerable. For the sake of high efficiency the core is impregnated with fluoride, about 50 per cent being the usual percentage. The golden-yellow arc is obtained from calcium fluoride, the white arc from cerium fluoride, and the red arc from strontium fluoride.



Large core Small core

Fig. 1—Cross-Section of Metal-Cored Flame Carbons.

In all cases the core is made by mixing finely ground carbon and fluoride with a solution of potassium silicate and pressing this mixture into the core canal of the electrode and drying at a suitable temperature. The secret of successful coring lies more in the composition of the silicate solution used than in anything else, as potassium silicate is a very indefinite compound, the alkalinity of which may vary over wide limits. The additional efficiency due to the flame-producing material in the negative electrode is only slight and is accompanied by a decrease in the steadiness of the arc. Hence it has become common practice to use ordinary core in the negative electrode for direct-current arcs. Hence, besides large-core flame-cored electrodes and small-core flame-cored electrodes, the author distinguishes as a third

group small-core ordinary-cored electrodes. In a special electrode of Blondel a very large central core is used with a very thin outer shell of pure carbon. In a 14-mm electrode the core is 9 mm in diameter and occupies, therefore, nearly one-half of the area. The percentage of fluoride can be increased in the Blondel core to 60 per cent, or even more, when a very distinct gain in efficiency is obtained. The core of the Blondel electrode is of different composition from the standard flame core, containing in addition to the fluoride and silicate a certain percentage of borates. The author gives data on the rate of consumption of electrodes and the steadiness of the arc and gives the results of candle-power measurements in the form of curves from different flame-arc lamps.—London *Electrician*, May 3, 1912.

Temperature of Filament and Specific Power Consumption.—M. VON PIRANI AND A. R. MEYER.—An account of an investigation carried out at the lamp works of the Siemens & Halske Company. For tungsten, tantalum and carbon tables are given which show the relation between watts per candle and black-body temperature and true temperature of the filament. The tests were made on lamps which had been burning for 100 hours or more so that no further aging was to be expected. For the same materials the candle-powers per square millimeter are given for a wide temperature range and are compared with candle-powers per square millimeter of a black body. From the surface brightness of the black body the effective wave-length of white light in the temperature range under discussion is found to be 0.586 μ.—*Elek. Zeit.*, May 2, 1912.

Color Correction in Mercury-Vapor Lamps.—A note on a new method of compensating for the lack of red rays in the light emitted from a mercury-vapor lamp which is due to Dr. von Recklinghausen, of Paris, and depends for its operation on the principle of fluorescence. An alcoholic solution of rhodamine is employed for this purpose, to which other substances are added to counteract its instability under the action of light. This solution is spread over a paper surface which is used as a reflector. In this way a white, and even slightly rose-colored, light can be obtained from the lamp. With a lamp arranged in this fashion it is noticed that the colors of various fabrics show no change when compared in daylight, and in this respect a much better result is obtained than with the metallic-filament lamp.—London *Electrician*, May 3, 1912.

Train Lighting.—C. TOONE.—A brief description of the cost of train lighting by gas or different methods of electric lighting. The author concludes that dynamo lighting is always preferable to storage-battery lighting for trains, and that the former will usually show a greater or less economy over ordinary incandescent gas lighting.—London *Elec. Review*, May 3, 1912.

Generation, Transmission and Distribution.

Swedish Water-Power Plant.—A fully illustrated description of the large station at Porjus, in Lapland, which is one of the power stations now in course of construction by the Swedish government. It is intended in the first instance to supply energy needed in connection with the electrification of the Kiruna-Riksgränsen railway, but it will also prove an important factor in the metallurgical industry. The climatic conditions are exceptional; in the course of the present winter the thermometer at Porjus has been down to as low a figure as — 57 deg. C. The first stage of the development of the power station will be 50,000 hp. The electric plant comprises three single-phase generators, each with a maximum rating of 10,500 kva, and three three-phase generators, each with a continuous capacity of 10,800 kva. One of the single-phase generators and one of the three-phase generators will be mounted on the same turbine shaft and will form a reserve. Some data are given on the cost of the erection of the plant and the transmission line.—London *Engineering*, May 3, 1912.

Norwegian Water Power Plant.—F. MARGUERRE.—The first part of a fully illustrated description of the Rjukanfos water-power plant in Norway, which has been erected especially for the fixation of atmospheric nitrogen. There are ten turbine-driven alternators of 17,000 kva rating, with a power-factor of 0.6, the emf being from 10,000 to 11,000 and the frequency 50 cycles. Nine of the ten generators are built in two halves, each generating 8,500 kva. The two halves can operate separately or can be operated in parallel. The construction of the various generators is described in detail.—*La Lumière Elec.*, May 4, 1912.

Swiss Water-Power Plant.—IDELBERGER.—A description of the Albuls plant, which contains eight generators, each of 2500 kva rating. Energy is transmitted to the city of Zurich over a distance of 136 km, or 82 miles, by means of three-phase circuits at 46,000 volts with a frequency of 50 cycles.—*Elek. Kraftb. u. Bahnen*, March 14, 1912.

Textile Industry.—O. REINHARDT.—The first part of an illustrated article on the use of electric motors in the textile industry. The author shows that the question of transmission losses is of no account either for or against the electric drive, but that the decisive elements are the increase and improvement of the output. The author begins to discuss the various machines used in the textile industry and methods of driving them by electric motors.—*Elek. u. Masch.* (Vienna), May 5, 1912.

Electric Motors in Steel Plant.—E. EICHEL.—A description of the electric equipment of the United States Steel Corporation's plant at Gary, Ind., with special reference to the power plant and the electric driving of the rolling mill. —*Elek. Kraftb. u. Bahnen*, Feb. 24, 1912.

Traction.

Electrolysis from Stray Currents.—GEPPERT AND LIESE.—An illustrated article on the troubles which have been experienced in the city of Karlsruhe in Germany with destruction of gas and water pipes by electrolysis due to stray currents from the rails of tramways. It is pointed out that a gas or water pipe will be destroyed at any place where electric current passes out of the pipe into the surrounding earth. It is not being destroyed, but is being protected on the contrary, at all places where current enters the pipe from the earth. The protective method adopted at Karlsruhe is based on this principle. At places where there would be danger for gas pipes or water pipes electrodes are placed in the earth in the neighborhood of the pipes and these electrodes are connected to the positive pole of a low-voltage generator or storage battery, while the pipe to be protected is itself connected with the negative pole. In this way electric current is forced to enter the pipe from the earth so that anodic destruction of the pipe is impossible. The power consumption is insignificant. The method is stated to have proved very satisfactory and its use is to be extended.—*Elek. Kraftb. u. Bahnen*, Feb. 14, 1912.

Berlin.—The complete official report on the proposed electric operation of the Berlin city and suburban railroads (Stadt-, Ring- und Vorortbahn). Locomotives will be used instead of motor cars. In rush hours the trains will consist of thirteen passenger cars with an electric locomotive at each end. Single-phase current is to be used at 15,000 volts with a frequency of 16⅔ cycles.—*Elek. Kraftb. u. Bahnen*, April 4, 1912.

Electrification of Trunk Railroads.—W. REICHEL.—A continuation of his long serial dealing with recent developments in trunk railroad electrification in Austria, Germany and Sweden.—*Elek. Kraftb. u. Bahnen*, March 4, 1912.

Bernina Road.—TH. KOLLER.—Continuation and conclusion of the detailed illustrated description of the electrical equipment of the Bernina Railroad. The present instalments deal with the converter substations, with the line construction and the rolling stock.—*Elek. Kraftb. u. Bahnen*, Feb. 14 and 24, 1912.

Wiesbaden.—Berlit.—An illustrated description of the

electric equipment of two suburban trolley roads in Wiesbaden. The electro-magnetic track brake is used. The trailers, which are of a particularly light construction on account of the heavy grades, are equipped with emergency brakes with storage batteries.—*Elek. Kraftb. u. Bahnen,* March 14, 1912.

Installations, Systems and Appliances.

Domestic Energy Rate.—A discussion of possibilities of devising an attractive rate for residences which would encourage more extended use of electric lighting. Mention is made of the rate recommended by the rate committee of the National Electric Light Association, according to which the number of active rooms in the house is multiplied by a certain number of kilowatt-hours, which gives the number of kilowatt-hours the consumer must use before he exceeds the first portion of the bill. All energy used up to and including the first portion is billed at a certain rate and the remainder or second portion at a much lower rate. Warrelmann in Potsdam, Germany, has devised a rate which is quite similar in principle. There are two rates—a fundamental flat rate and an additional rate of 2.5 cents per kilowatt-hour. The novel feature is the method of determining the fundamental flat rate. This is based on the number of rooms in the residence, the consumers being divided into classes accordingly. For each class the rate is so chosen that the bill would be exactly the same as in former years if the kilowatt-hours consumed remained the same. From the bills for the last year the number of kilowatt-hours consumed are taken and the charge is calculated as if 2.5 cents had been paid per kilowatt-hour. Of course, the real charge has been greater. Now, the difference between the real charge that has been paid and the charge calculated at 2.5 cents per kilowatt-hour is the fundamental charge of the new rate. For all kilowatt-hours consumed an additional rate of 2.5 cents per kilowatt-hour is charged. If the consumer would use exactly as many kilowatt-hours as before, he would, therefore, pay just as much as heretofore. But, as the kilowatt-hour costs only 2.5 cents, he will now use more than heretofore. It is thought that the Potsdam rate encourages consumption to a greater extent than does the rate of the National Electric Light Association.—*Elek. Zeit.,* May 2, 1912.

Insulating Materials.—H. Passavant.—A long report on the work of the committee on insulating materials of the German Association of Electrical Engineers. The scope of the investigation was restricted for the present to operating emfs not above 500 volts and to tests of artificial insulating materials which consist essentially of inorganic substances with organic binding materials. The scope of the tests was very broad, however, including mechanical tests, chemical and physical examination and electrical tests. The former two tests were carried out by the German Bureau for Testing Materials and the electrical tests by the German Reichsanstalt. An illustrated account of the investigations of the Bureau for Testing Materials is first given. These researches related to mechanical and technical properties (mechanical strength and ease of machining), to the behavior at higher temperatures (refractoriness, behavior under pressure when heated and tendency to ignition), and to chemical properties. The investigations of the Reichsanstalt related to the insulating resistance, the surface resistance, the perforation voltage, the change of insulating resistance and the surface resistance due to the chemical action of water, sulphuric acid, ammonia vapors and lubricating oil, the change of surface resistance due to illumination and influences of the atmosphere, the behavior of the surface of the material after having been burned by an arc, and the action of higher temperatures on surface resistance and insulation resistance. A graphical method is described for representing in a diagram the different properties which determine the quality of an insulating material. —*Elek. Zeit.,* May 2, 1912.

Earthed Versus Insulated Neutrals in Colliery Installations.—R. W. Peters.—A note on a recent paper read before the East of Scotland Branch of the Association of Mining Electrical Engineers. At the outset the author outlined the principal advantages of each system as follows: Earthed neutral: (1) The maximum potential to earth of any phase is limited to 58 per cent of the line voltage; (2) the danger from shock is greatly reduced because contact with any phase and earth is only 58 per cent of the line voltage; (3) leakage tripping devices can be used which will switch off the supply when an earth connection occurs on any phase (this reduces danger of shock and explosion); (4) leakage to earth results in isolation of a defective circuit. Insulated neutral: (1) It is possible to run a system with one phase earthed; (2) two phases must go to earth or be short-circuited before the supply is interrupted; (3) there is supposed to be less electrical stress on the insulation. In the course of the paper the author said he favored the earthing of the neutral. This decision was arrived at after sixteen years' experience in mining electrical work, both on high-tension and low-tension three-phase plants and on large direct-current insulated systems. He, therefore, claimed to have had special opportunities of observing the results of earthing. At the same time he did not mean to imply that earthing the neutral point is the cure-all for electrical troubles in mines, for good insulation must not be lost sight of. He strongly advocated the earthing of the neutral at one point through a resistor of suitable resistance in all cases of three-phase supply. He believes in having armored cables throughout and the motor frames, switch-boxes, joint-boxes, gate-ends and the like thoroughly bonded and earthed. He further advocates the use of tripping devices.—London *Electrician,* May 3, 1912.

Units, Measurements and Instruments.

Electrostatic Voltmeter.—An illustrated description of the Siemens electrostatic voltmeter for very high pressures. The construction is shown in Fig. 2. The upper terminal is attached to the metal case containing the scale. The other terminal is attached to the bottom of the metal pan surrounding the glass vessel filled with oil, this metal pan forming the fixed electrode. The moving electrode *a* is in the form of a cup-shaped, closed, hollow body containing air. It is rigidly connected with an aluminum rod *b*, which moves in the metal tube *c* between small guide pulleys *d*. The aluminum rod *b* is suspended by a metallic filament, which is attached to a cam *e*, on the spindle of the pointer. A spiral spring provides the opposing force to the rotation of the pointer produced by the attraction of the electrodes, and the pointer movement is practically dead-beat. The metal tube *c* carries a plate on which the moving system is secured, and also, independently of the plate, the metal case illustrated. The lower end of the metal tube *c* is extended in the form of a bell-shaped screen *f*. As this screen is of the same potential as that of the moving

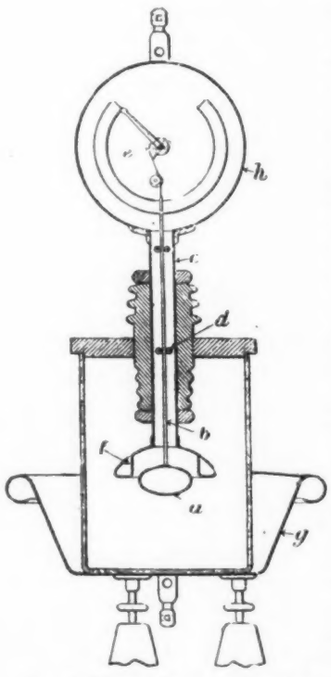
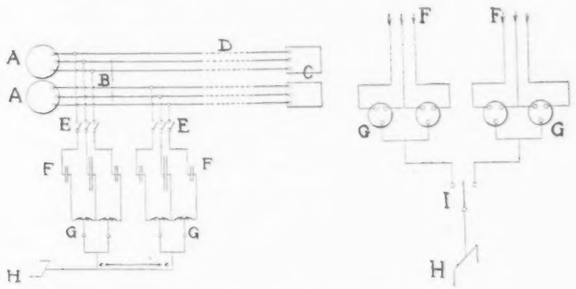


Fig. 2—Electrostatic Voltmeter.

electrode, it increases essentially the accuracy at the commencement of the scale, owing to the repelling effect which it produces on the movable electrode. The scale is practically proportional from about 30 per cent of the maximum deflection. The important problem of rendering the readings of the instrument independent of external influences, and particularly of the disturbing effects of neighboring earthed conductors, has been completely solved by means of the screen *f*, in combination with the metal pan *g*. The employment of oil as a dielectric has the advantage, first, that the attractive force is greater in oil than in air, in consequence of the high dielectric constant of oil, and, second, that oil has a greater disruptive strength and affords at the same time protection against disturbances due to atmospheric influences.—London *Electrician*, May 3, 1912.

Connection of Static Voltmeters.—L. BERNARD.—In a large power plant the author found two static voltmeters connected as shown in Fig. 3. Two generators *A* supply two transmission lines *B* and transformers *C*. The two transmission lines are not electrically coupled together. *E* are switches, *F* condensers, *G* static voltmeters and *H* the earth. The voltmeters connected in this way are suitable for insulation tests only as long as merely one machine with its transmission line is loaded. When the other machine is also started the needles of the two voltmeters begin to show irregular oscillations. The reason is that the two machines are now electrically connected together through the earth connection *e e*, and the two needles of the two static voltmeters are now deflected just as in a synchronizing apparatus. Of course, under these circumstances they are not suited for indicating the insulation conditions. To remedy this the connections shown in Fig.

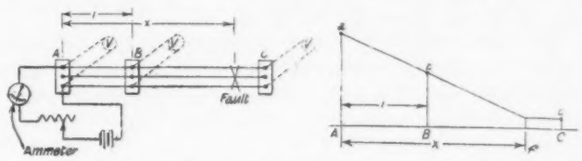


Figs. 3 and 4—Connections of Static Voltmeters.

4 may be used. F represents the connections from the condensers to the static voltmeters *G*, while *I* is a switch and *H* the earth. Now either the one or the other voltmeter will be used for testing the insulation of one or the other line. For practical purposes it may be so arranged that the switch is automatically changed from one to the other contact at regular intervals.—*Elek. u. Masch.* (Vienna), April 21, 1912.

Vacuum Thermal-Junction.—A. H. PFUND.—An abstract of an American Physical Society paper on a sensitive black-body-vacuum thermal junction and a method of producing high vacua. The metals used in the construction of the junctions are the well-known "bi" alloys of Hutchins. The filaments used in the junctions are about 0.15 mm wide and about 0.01 mm thick. The methods of soldering and of mounting are described and results of experiments are given which show that the junction in vacuum with reflecting inclosure gives a sensibility more than thirteen times the same junction in air without reflecting inclosure. For producing the vacuum the author makes use of the phenomenon of self-evacuation exhibited by vacuum tubes.—*Physical Review*, March, 1912.

Fault Localization on Mining Cables.—G. B. BURROWS.—A paper read before the North of England Branch of the Association of Mining Electrical Engineers. In discussing testing methods for earths, the author outlined the simple drop of potential method, passing a known current through the fault from the two ends of the cable in succession and noting the drop on the cable with a millivoltmeter in each case. He then described the well-known Murray loop test with a slide-wire, but mentioned that the Varley loop test,



Figs. 5 and 6—Methods of Fault Localization on Cables.

which takes into account copper resistance, is hardly suitable because of the heavy section of mains. Short-circuits are usually more difficult to find, but if at the same time the cable has broken down to earth, the foregoing test can be applied if it is possible to use a sound core as the return circuit. The drop-in-potential method can be used if a test wire is available. A method used by the author on short-circuit faults is shown in Fig. 5. *A, B, C* are disconnecting points on a cable of uniform sectional area. The current must be kept constant during the test and the drop of potential is measured at each of the points *A, B, C*. If the fault has any resistance at all, a small reading will be obtained at *C*. The values are plotted on squared paper, as in Fig. 6, and the point of intersection is the position of the fault. For locating discontinuities he described a method depending on the capacity. The cable is charged up by a battery and discharged through a ballistic galvanometer by a suitable key. This is repeated from the other end, when the distance of the fault can be calculated. —London *Elec. Engineering*, May 2, 1912.

Small Air Condensers.—C. E. HAY.—An illustrated article in which the author describes some observations made with small air condensers. It was found that their capacity was different when the connections of the condenser to the circuit were reversed. This was found to be the case for all condensers he experimented with, although it was more difficult to observe the phenomenon with direct current than with alternating current. The phenomenon was finally traced to the fact that one set of the plates of the condenser had a greater capacity to earth than the other set. The practice of screening small air condensers by inclosing the whole condenser in a metallic receptacle joined to one set of the plates increases the difference in the capacity of the condenser very markedly. The experiments show that in the design of small air condensers, especially for high-frequency work, whether screened or unscreened, the capacity to earth of each set of plates should be equal. —London *Elec. Review*, May 3, 1912.

Notation.—A table of certain physical quantities and the symbols of notation proposed for the same by the joint committee on units and notation of varying German and Austrian societies, together with some explanatory notes.—*Elek. Zeit.*, May 2, 1912.

Miscellaneous.

Copper.—J. B. C. KERSHAW.—A statistical article on the present position of the copper market as regards production and price. From his study of the relationship between the figures for the production, consumption and price of copper during the past few years he reaches the conclusion that the metal is governed by the customary economic laws of supply and demand, and that, given a continuance of the present trade activity, the price of the metal may rise considerably higher than the level yet touched. Yet the author's advice to large consumers of the metal is to buy cautiously and not to commit themselves too far ahead, the present position of the copper market being one which demands on the side of the buyers a policy of merely covering the immediate requirements of the moment.—London *Elec. Review*, May 3, 1912.

Book Reviews

The Measurement of High Temperatures. By G. K. Burgess and H. Le Chatelier. Third edition, rewritten and enlarged. New York: John Wiley & Sons. 510 pages, 178 illus. Price, $4.

The third edition of this standard treatise on the measurement of high temperatures has been entirely rewritten and greatly enlarged, which action became necessary owing to the great advances made since 1900, the date of first publication. At that time the work of Le Chatelier alone represented the greatest modern advance in high temperature measurement, but in recent years many workers have entered the field and cultivated it intensively or greatly extended its boundaries. In this connection it is merely necessary to mention the development of gas pyrometry, the application of the laws of radiation to pyrometry and the great advances in thermoelectric and electric-resistance pyrometry and in the automatic recording of temperatures.

Following are the chapter headings of the book: Standard scale of temperatures; gas pyrometer; colorimetric pyrometry; thermoelectric pyrometer; electrical resistance pyrometer; the laws of radiation; radiation pyrometer; optical pyrometer; various pyrometric methods; recording pyrometers; standardization of pyrometers. In an appendix is an excellent bibliography of twenty-four pages and a number of tables, including a table of melting joints. The book should find a place in the library of every engineer as a work of reference, or for the pleasure of reading what represents one of the most interesting branches of applied science.

Design of Electrical Machinery. Vol. I. Direct-Current Dynamos. By William T. Ryan. New York: John Wiley & Sons. 109 pages, illus. Price, $1.50.

A manual of direct-current machinery design. It is intended to guide the student of electrical engineering who commences his practical experience as a direct-current machine designer. The book is available as a textbook in electrical machine design in college and also as a guide to the practitioner engaged in construction. There are three chapters dealing respectively with the following subjects: The design of direct-current constant-potential generators; illustrative designs; design of a 300-kw, 90 r.p.m., 125-volt direct-current generator. The descriptive treatment is clear and the illustrations good.

Transformers. A Treatise on the Theory, Construction, Design and Uses of Transformers, Auto-transformers and Choking Coils. By Hermann Bohle and David Robinson. London: Charles Griffen & Company. 356 pages, illus. Price, $7.50.

The preface states that the object of this work is to give a thorough exposition of the scientific principles upon which the transformer is based, of the application of these principles to the design of such apparatus, their construction and use.

The section on design will be found useful by those actually engaged in the work of designing, but has rather too much the characteristics of a handbook to be of service to those who seek only a knowledge of principles of design and do not care for drafting-board minutiæ. The section on testing transformers and that dealing with operating connections are, however, of more general value. While the theory of the apparatus is well covered, its development is far from logical, and the use of heterogeneous units and symbols renders the book difficult to the student. The spirit in which this section and, in fact, the whole book is written is revealed in the preface, where it is stated that "Engineers have already thrown over the c. g. s. unit of magnetic field in favor of the ampere-turn per millimeter or inch; we would like to see them emancipated in the same way from the line and its derivation, practically the only c. g. s. units that they so employ. The volt-second and its thousand submultiples are in reality more convenient and belong to the same system as the other electrical units in use." As a result of this method of disregarding established units and symbols, one must learn, before he can read the work intelligently, the personal system of the authors, and the book scarcely justifies this labor except in the case of specialists in transformer design.

Calcul et Construction des Alternateurs. By Henri Birven, professor at the Berlin Trade Institute. Translated from the German into French by P. Dufour. Paris: Gauthier-Villars. 179 pages, 126 illus. Price, 6 francs.

This addition to the "Bibliothèque Technologique" is worthy of translation from the German into the French language on account of the clear and simple exposition given by the author of the principles of calculation of single and polyphase alternators. The first part of the volume treats of alternating-current theory with a minimum use of mathematics, and the second part deals with the constructional details of alternators. The final chapters, which form the chief value of the book, treat of the calculation of alternators. While too elementary for the professional designer, this section will be of much value to the student owing to its clear and logical method. Four plates of sectional drawings of alternators conclude the book.

A Handbook of Wireless Telegraph. Its Theory and Practice. Third edition. By James Erskine Murray. New York: D. Van Nostrand Company. 386 pages, 186 illus. Price, $3.50.

That this practical treatise on wireless telegraphy meets a need is indicated by the call for a third edition within four years. The book is not intended for the uninitiated, but, as stated in the preface, for those who have, for reasons of business and pleasure, already made themselves acquainted to some extent with the theory and practice of wireless telegraphy. The contents consist in great part of quotations from the writings of authorities on wireless telegraph or of inventors, which is far from being a satisfactory method of exposition. Nevertheless, the book will be found of value to all interested in wireless telegraphy from its descriptions of standard forms of apparatus and its statements—usually quite free of mathematics—of authoritative theories of wireless action.

A chapter has for a caption "Theory of Jigs and Jiggers," and one puzzled by this nomenclature is still further nonplused when he encounters for the first time, several pages from the opening of the chapter, the term "jig," in the following sentence: "With the capacities and inductances usually available, the oscillations of the current are of such high frequency as to constitute a jig." Search for the meaning finally led to the preface, where the author states that to high-frequency alternating current, such as is used in wireless telegraphy, he applies the term "jig," the term "jigger" being used for high-frequency circuits!

The Earning Power of Railroads 1912. Compiled and edited by Floyd W. Mundy, of James H. Oliphant & Company. New York: Moody's Magazine Book Department. 526 pages. Price, $2.50.

The book contains in a very compact form the principal financial statistics of about 150 railroads in the United States, representing nearly 250,000 miles of main track, as derived from official annual railroad reports. The data provided are in brief the track length, income, operating expense, surplus, outstanding stocks and bonds, capitalization, as well as a short analysis of income and operating accounts. A brief financial history of each railroad is also given in a separate section of the book. The book will be useful to investors and to all interested in railroads.

New Apparatus and Appliances

RIGID IRON CONDUIT.

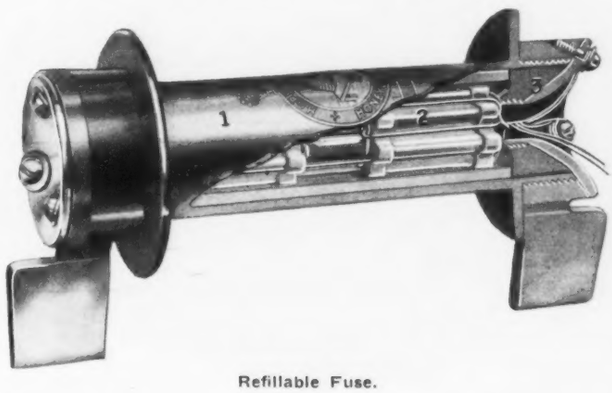
It is claimed that the "Greenfield Duct" rigid iron conduit, which is treated with hot galvanizing on both the interior and exterior surfaces, withstands a standard sulphate of copper dip test equivalent to at least seven ordinary dips. The coating is said to be able to withstand rusting successfully. This conduit has recently been placed on the market by the Sprague Electric Works of the General Electric Company, New York, N. Y.

EXHIBITS AT NEWARK EXPOSITION.

Among the 196 exhibitors at the Newark (N. J.) Industrial Exposition, which is confined to Newark enterprises, are many electrical firms, including the General Electric Company, the Westinghouse Electric & Manufacturing Company, the Crocker-Wheeler Company, the Sprague Electric Works, the Public Service Electric Company, the Lansden Company, the Atlantic Vehicle Company, the Bell Electric Motor Company, the Newark Electrical Supply Company, the Driver-Harris Company, the Beaver Engineering Company and the Scott Electrical Company. All of the machinery is operated by electrical energy supplied by the Public Service Electric Company, through a Crocker-Wheeler motor-generator set which distributes it to fourteen different booths besides running the four illuminated electric fountains which are among the most attractive decorations.

REFILLABLE FUSE.

Illustrated herewith is a refillable fuse of the so-called honeycomb type. It consists of three main parts: 1, the outer cord; 2, the "honeycomb" which fits closely into the outer cover, and 3, the baffle plates which are placed on each end. The honeycomb consists of a cylindrical china body, on the outer surface of which are a number of cells in which the fuse wires are placed, while through the center of this body there is a hole with a tapered opening at either end.



Refillable Fuse.

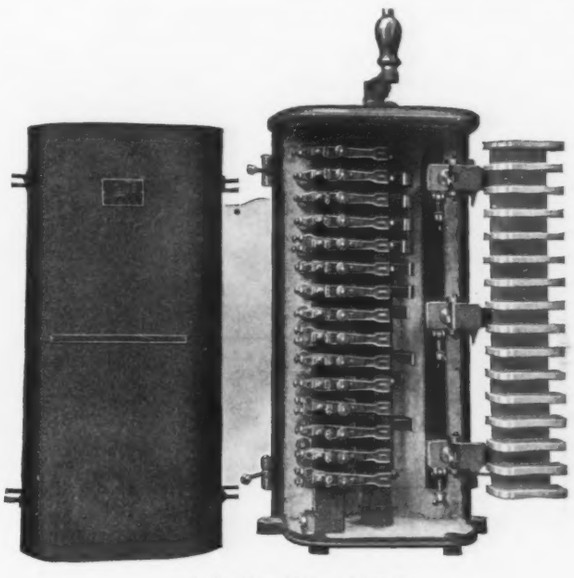
This central chamber serves as an expansion chamber. Round the center portion of the outer surface of the honeycomb cylinder a tin time element band is fixed. The wiring of the fuse consists of two parts. In the center a fusible tin band is connected to the terminals by copper strands. There are also a number of small through copper strands, varying in number from three to six, according to the size of the fuse.

The action of the fuse is as follows: Running on a small load, the copper through-strands carry the bulk of the current because the resistance of the through-strands is lower than that of the fusible tin band. As the load increases, however, the temperature of the copper through-strands rises, and the resistance of these strands becomes greater until a portion of the current is shunted and carried by the fusible tin band. When the load exceeds the maximum continuous rating of the fuse the temperature rises until the fusible tin band is melted. All the load is then thrown on the copper through-strands, which immediately fuse. It will be seen therefore that on overload conditions the break takes place on the copper through-strands only, and consequently a comparatively small mass of metal is volatilized. On a heavy short-circuit the case is different. The fusible tin band is then as a rule left unfused, the connecting copper strands fusing instead. The tin is found to volatilize on rare occasions. This method of wiring tends to give a very heavy overload capacity for short periods, and at the same time the provision of the fusible tin band definitely controls the overload.

The fuse which is described above has been placed on the market by Parmiter, Hope & Sugden, Hulme Electrical Works, 50 Ellesmere Street, Hulme, Manchester, England.

INDUCTION MOTOR STARTERS.

The accompanying illustration shows the general construction of a line of starters and speed regulators for slip-ring induction motors similar in general appearance to direct-current drum controllers. The same kind of non-stubbing, straight-line contact fingers are used. An arc-proof shield is mounted under the fingerboard and so slotted as to interlace with the deflectors, preventing burning of the



Induction-Motor Starter.

board and the communication of the arc from one finger to another.

The operation is with an easy and smooth rotary motion. With the starter the external resistance is entirely cut out of the rotor circuit when running normally, while with the speed regulator the operating handle may be moved backward or forward according to the variation in speed desired. Standard regulators are arranged to give 50 per cent speed

reduction. The resistance used with these controllers varies according to the duty—whether for starting only or for regulating. The cast-metal grids are mounted in special mill-end frames on two supporting rods. These rods are covered with mica tubing and are also insulated from the end frame by fiber washers and tubes. The above-described devices have been developed for the market by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

SYNCHRONOUS BOOSTER CONVERTER.

Herewith is illustrated a synchronous booster converter which has been developed for delivering variable unidirectional voltage when the energy is supplied over constant-

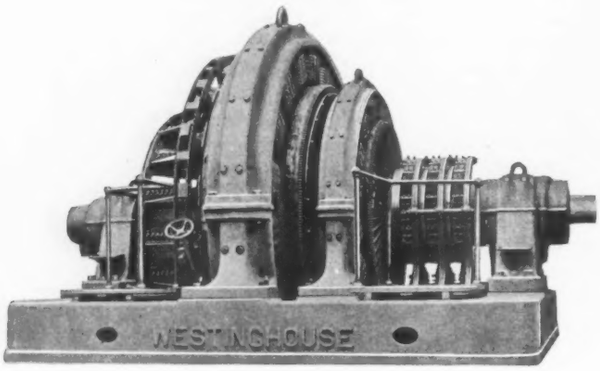


Fig. 1—Synchronous Booster Converter.

potential alternating-current mains. The machine consists of a synchronous converter connected in series with the armature of an alternating-current generator mounted on the same shaft. By varying the excitation of the alternator the voltage impressed on the collector rings of the converter proper can be increased or decreased as desired, and the voltage delivered at the commutator can be varied accordingly.

It is claimed for this machine that it possesses the following advantages over the simple converter equipment with an induction regulator: There is only one unit and thus the floor area required is minimized and the connections are simplified; the operation is reliable because the apparatus is not subject to dangerous distorting forces. Compared with the "split-pole converter," it is said that the booster converter has the following advantages: Higher efficiency, particularly at the lower voltages; better com-

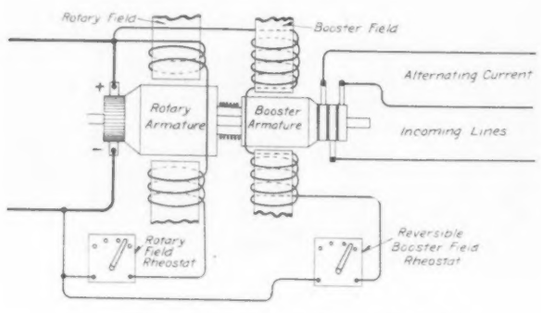


Fig. 2—Circuit Diagram of Booster Converter.

mutation, particularly at the maximum voltages and maximum load, when good commutation characteristics are essential; smaller weight and floor area requirements, particularly for 60-cycle units.

The above-described machine has been standardized by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

SWISS INDUCTION MOTORS.

Herewith are illustrated some of the most recent types of induction motors built by the Oerlikon company, Zurich, Switzerland. The present motors embody designs which are suitable for running at speeds up to 1000 r.p.m. and they are now constructed in sizes up to 300 hp with the use of bracket bearings, and in larger sizes with foundation plate. For the smaller motors of the first kind use is in general made of from six to sixteen poles. The construction of motors with bracket bearings or foundation plates

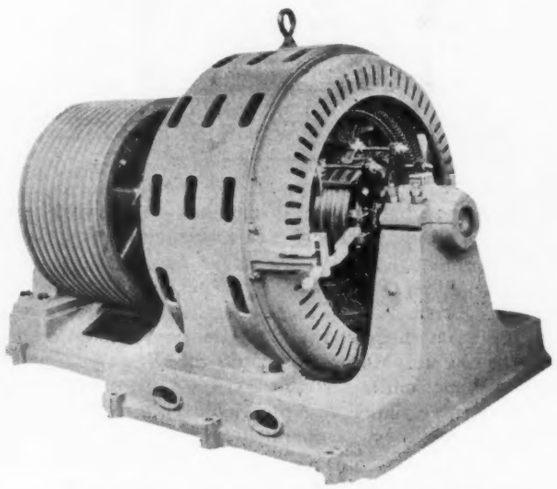


Fig. 1—Three-Phase Motor with Short-Circuiting Device.

is about the same. The brackets or end plates are made so that they can be displaced by 90 deg. or 180 deg., and in this way the motor can be fixed to a wall or to the ceiling, while keeping the shaft horizontal. Fig. 1 shows a high-power motor with foundation plate and upright bearing brackets. One point to be noted is the use of a combination device for short-circuiting the armature and also raising the brushes. The short-circuiting is carried out in the

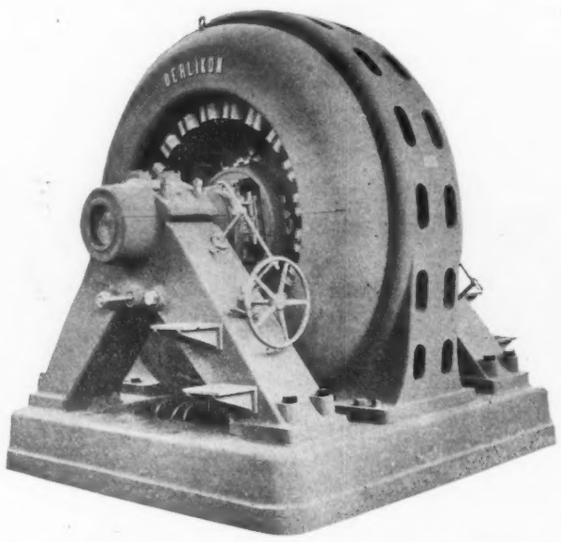


Fig. 2—2700-hp Induction Motor with Secondary Rheostat.

new design by means of a collar having contact projections which are introduced under the collector rings. Combined with this is a device for lifting up the brushes as soon as the armature is short-circuited. Such a device is operated in the smaller motors by means of a hand-wheel and in the other type by the use of a lever. In most cases the end plate of the motors is of the open kind, as will be seen in

Fig. 1, but where there is need of protecting against splashing or dripping of water another design is employed for the end plate so that it nearly incloses the motor.

When the motor is required to start up with only one-quarter the maximum load, as is usually the case with motor generators, the starting rheostat is fixed to the rotor in the shape of coils, as shown in Figs. 2 and 3. The resistance is gradually decreased and finally the rheostat is short-circuited by the use of a collar provided with contact projections which is worked by a hand-wheel. A stopping pawl or bolt which the operator is obliged to throw off by hand at each revolution of the wheel requires him to stop at each degree of speed. The great advantage of this construction, which has already been applied with success in a number of cases, is the elimination of rings and brushes on the rotor.

Fig. 3—Secondary Rotor of 2700 Resistances.

Another new design is that of a motor with starting rheostat permanently bolted on one side of it so as to form a single apparatus. In this case the resistor is placed in a cast-iron box filled with oil. The starter is combined with the device for short-circuiting the secondary and raising the brushes which was mentioned above, so that working the same hand-wheel performs all three operations of decreasing the resistance, short-circuiting the rheostat and lifting the brushes, and this is always done in the right order for starting or stopping the motor. Thus a wrong manipulation is impossible and hence the latter type of motor is very well adapted to be used in plants where the motors are in charge of more or less inexperienced persons.

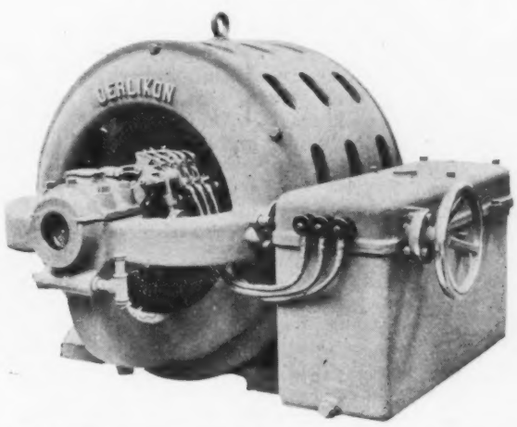


Fig. 4—Motor with Self-Contained Starting Rheostat.

A SERVICE ENTRANCE HOOD.

The service entrance hood here illustrated is said to possess several unique advantages. It is listed by the manufacturer as a "service entrance adaptibox," and its points of superiority are the adaptable features of the connector lugs and the porcelain cover. The unit consists of three parts, the hood, the connector lug and the cover. The porcelain cover permits the use of any number of wires from one to nine, the center hole being surrounded by eight knock-outs so that by simply punching out the required number of seals openings are provided for any desired combination of circuits. Two sizes of hood are used, each of which accommodates two sizes of conduit lug. The smaller hood takes 0.5-in. to 0.75-in. and the large 1-in. to 1.25-in. conduit.

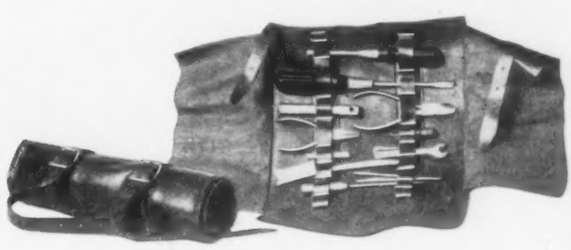
Service Entrance Hood.

The entrance hood which is here described has been placed on the market by the Bonnell Manufacturing Company, Cleveland, Ohio.

METER REPAIR KIT.

The watt-hour meter repair kit illustrated herewith is designed for the convenience of meter testers and repair men and contains all the tools usually required for this work. The loops for holding the tools are adjustable, so that different tools may be added or substituted as desired to meet special conditions. The case is made of strong, pliable black leather, especially selected, with retaining flaps of the same material and two leather binding straps. The kit contains the following tools:

One 4-in. screwdriver, one 2½-in. screwdriver, one 4-in. pin screwdriver, two No. 0 flat wrenches, one socket wrench one pair of 4-in. diagonal cutting pliers, one pair of 3-in flat, long-nose pliers, one pair of tweezers, one toothbrush, one pocket level and one bottle of watch oil.



Meter Repair Kit.

This convenient meter repair kit is manufactured by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Industrial and Financial News

FURTHER progress has been made this week along industrial lines, and the business situation seems greatly strengthened. Much of the improvement has been attributed to resumption of work in the anthracite fields following the adoption of a four-year agreement between operators and miners. Settlement of these differences and removal of prospects of a strike on the Eastern railroads for several months at least, during which the grievances will be the subject of arbitration, have been the cause of substantial growth in confidence. Less reserve is apparent in transactions and in the formation of new enterprises. The scale of operations in the iron and steel trades is very large, in many cases demand exceeding capacity. Improvement is general throughout the metal markets, rise of copper prices to 16¾ cents per pound being a feature of the week, and the outlook for trade expansion seems more than favorable. Conditions in the money markets show little change. Rates in New York May 22 were: Call, 2½@2¾ per cent; ninety days, 3¼@3½ per cent.

United Gas & Electric (Conn.) Merged with Susquehanna Railway & Light.—The United Gas & Electric Corporation, of Connecticut, which was incorporated in Connecticut on March 8, 1912, by Bertron, Griscom & Jenks interests, has acquired the United Gas & Electric Company of New Jersey and, it is stated, will absorb by merger the Susquehanna Railway & Light Company. The company has also secured control of the International Traction Company, Buffalo, N. Y.; the Consumers' Electric Light & Power Company, New Orleans, La.; the Houston Gas & Fuel Company, Houston, Tex., and the Harrisburg Electric Service Company, Harrisburg, Pa. After consolidation with the Susquehanna Railway & Light Company the new company will be capitalized as follows: $25,000,000 of authorized 6 per cent cumulative preferred stock, $20,000,000 of authorized common stock and $7,500,000 of three-year convertible 5 per cent secured notes. The preferred stock is to be 6 per cent cumulative until April, 1915, after which the dividends are to be at the rate of 7 per cent. Of the authorized $25,000,000 of preferred stock, $9,463,100 is outstanding, $1,172,170 having been issued for equal exchange for preferred stock of the United Gas & Electric Company of New Jersey, $7,500,000 being reserved for convertible notes and $6,864,730 being in the treasury. Of the common stock, $8,380,000 has been issued and $11,620,000 is in the treasury. Of the $7,500,000 of three-year convertible 5 per cent secured notes $3,300,000 have already been issued, $2,200,000 are to be issued to purchase bonds of the United Gas & Electric Company of New Jersey and for working capital, and $2,000,000 is to be retained in the treasury. The notes are to be convertible after April 1, 1914, into preferred stock of the company par for par. The management of the new companies will be in the hands of the same organization which has operated the Susquehanna Railway, Light & Power Company, while the International Railway, Buffalo, will be under the direct supervision of T. E. Mitten, formerly president of the Chicago City Railway and now chairman of the executive committee of the Philadelphia Rapid Transit Company, of Philadelphia, Pa.

First Doherty Organization Investing Company.—As a result of a desire that each employee of the various companies managed and operated under the supervision of the Doherty organization shall save some portion of his income, regardless of its size, and shall have an opportunity to invest such savings safely, with a good return, Henry L. Doherty & Company have prepared a plan for organizing an investment association for this purpose, to be known as the First Doherty Organization Investing Company. The capitalization of this company will be determined by the amount of the subscriptions received and will be divided into preferred and common stock in the ratio of ten to one. The former will be preferred as to dividends at the rate of 6 per cent. To provide for the small investor and the investor desiring the maximum degree of safety, the board of directors will authorize the issuance of certificates of indebtedness not exceeding in total amount the paid-in capital and surplus. These certificates will be in denominations of one dollar, five dollars and ten dollars, to be payable on or before six months after demand, with interest at the rate of 4 per cent per annum, compounded quarterly, the interest to be payable at the time of payment of the certificate. To encourage saving and thrift in the small wage earner and in even the youngest members of employees' families, the company will issue stamps in the denominations of 5 and 10 cents. Whenever stamps in amounts of even dollars have been accumulated they may be exchanged for equal amounts in certificates of indebtedness bearing interest at 4 per cent. The management of the company will be in the hands of a board of directors of eleven members.

Georgia Public Service Corporation to Serve Macon, Ga.—W. J. Massee, formerly president of the Macon Railway & Light Company, Central Georgia Power Company, Macon Gas Company and the Central Georgia Transmission Company, is at the head of the Georgia Public Service Corporation, which expects to go extensively into the lighting and street-railway business in Macon, Ga. J. T. Nylan, formerly general manager of the above-named companies, is associated with Mr. Massee in the project, and, according to statements made by him, the Georgia Public Service Corporation has secured rights to operate on a number of streets not occupied by the Macon Railway & Light Company. Orders have been placed with the Allis-Chalmers Company for two turbine units and attendant equipment. These units will be rated at 1500 kw and 500 kw respectively. Contracts have been placed with the Erie City Iron Works for boilers. As the manufacturers in closing the contracts guaranteed delivery forty days from the date of receipt of order, the Georgia Public Service officials expect to have the plant in operation within three months. The Schofield Engineering Company, of Philadelphia, are the consulting engineers for the Georgia corporation.

Splitdorf Electrical Company Formed.—Incorporation of the Splitdorf Electrical Company under the laws of New Jersey, with a paid-in capital of $3,500,000, to manufacture ignition and lighting devices has been announced. John T. Alvord, associated with the Torrington Company, Torrington, Conn., manufacturers of motor cycles and motorcycle supplies, and also associated with various organizations dealing in automobile and motor-boat accessories, is president of the new company, and Charles F. Splitdorf, of C. F. Splitdorf, Inc., manufacturer of magnetos and ignition devices, which company has been absorbed by the new concern, is vice-president. The company has been organized as an entirely new concern with a stock issue divided into $1,500,000 7 per cent cumulative preferred shares and $2,000,000 in common stock. Among the men associated with Mr. Alvord and whom he has brought with him into the new concern are Bryant S. Keefer, who has been elected treasurer, and Charles W. Curtis, who becomes secretary and general manager. Messrs. Alvord, Splitdorf, Keefer, Curtis and Viles compose the board of directors.

Annual Report of Westinghouse Electric & Manufacturing Company.—The report of the Westinghouse Electric & Manufacturing Company for the fiscal year ended March 31, 1912, details of which can be found on page 1099 of this issue, showed gross earnings of $34,196,446, as compared with $38,119,312 in the previous year, when the showing was the best in the company's history. The net income was $2,444,093, which after allowing 7 per cent dividends on the $3,998,700 preferred stock left a balance of $2,164,184. This is equal to 5.89 per cent on the $36,700,287 common stock, and compares with 12.34 per cent earned on the common stock in the previous year. Guy E. Tripp, chairman of the board of directors, attributes the decrease in earnings partly to a reduction in output and partly to the lower prices obtained during the year. The anual meeting of the stockholders of the Westinghouse Electric & Manufacturing Company will be held at Pittsburgh on June 12.

Financial Statement of J. G. White & Company, Inc.—The ninth annual report of J. G. White & Company, Inc., covering operations for the fiscal year ended Feb. 29, 1912, shows an increase in surplus from $485,529 to $605,522, after having paid the regular 6 per cent dividend on the company's outstanding preferred stock. This is equivalent to about 8 per cent for the year on the common stock. President White states that this increase in surplus is shown after having made what the officers of the company believe to be ample provision for all doubtful accounts and after the securities owned by the company have been valued by a committee of the directors on what is believed to be a sound and conservative basis. He adds that satisfactory earnings, as well as increases in rates of dividends, have been shown during the past year on a number of the properties in which the company holds securities, this being particularly true of some of the properties operated by the company. Earnings in excess of those in the past year are expected during the present year in view of the business in hand and in prospect. The balance sheet as of Feb. 29, 1912, shows total assets of $4,860,267 as follows: Goodwill, purchase of business, plant, tools, instruments, etc., $1,499,037; deferred charges and plant, tools and equipment, less depreciation, $144,884; securities owned and syndicate participation, $2,271,807; bills received, $242,013; accounts receivable, $360,933; interest and dividends accrued, $8,624; cash in bank and on hand, $317,211; working capital and cash in branch offices, etc., $15,755. The authorized capital of the company is $5,000,000 stock, of which $2,000,000 is common, in shares of $100 each, and $3,000,000 is 6 per cent cumulative preferred in shares of the same denomination. Of the common $1,500,000 is issued and of the preferred $2,000,000 is issued, making a total of $3,500,000. Other liabilities are: Bills payable, $656,624; accounts payable, $68,120, and $30,000 to sundry stockholders for dividend on preferred stock, payable May 1, 1912.

Cleveland Telephone Asks for Authority to Increase Its Capital Stock.—Last week the Cleveland Telephone Company, through S. H. Tolles, an attorney of Cleveland, and H. O. Seymour, of Chicago, representative of the Bell interests, filed an application with the Ohio Public Service Commission for authority to increase its capital stock by $900,000. Mr. Tolles informed the commission that the funds secured from the sale of the stock would be used for paying a portion of the company's debts. At a hearing on the matter the commission requested an inventory and appraisal of the property, after the receipt of which, it was stated, a representative of the commission would go to Cleveland to verify the report. A. B. Crumden, general bookkeeper of the company, testified that for the past twelve years the Western Telephone & Telegraph Company has financed the Cleveland company. He said this company now holds notes aggregating $3,007,130 and that if the new issue of stock is granted it will be applied on this debt. These loans, he said, began July 16, 1900, and were in amounts from $5,000 to $55,000. Of the entire amount, $302,500 has been borrowed since June 30, 1911. The commission was informed that the assets of the company are about $7,000,000 and the liabilities about $6,000,000. Commissioner Hughes expressed doubts as to whether a public utility company may create an indebtedness by giving notes and then pay these notes by issuing additional stock. As neither the president nor the secretary of the company was present, the commission adjourned the hearing until the appraisal is made and these officials are able to appear. Assistant City Solicitor Stockwell of Cleveland, who was present to represent the administration, insisted that if the company is allowed to issue additional stock now it will repeat the request within a short time and that there will be no end to the procedure.

H. M. Byllesby & Company Drop Toledo Railways & Light Reorganization.—Owing to the unsettled political situation prevailing in the State of Ohio, H. M. Byllesby & Company, of Chicago, who have been making an examination of the properties of the Toledo Railways & Light Company, with a view to purchasing them and reorganizing the affairs of the company, as noted in these columns March 23, have concluded that it would be unwise to bring out new securities for this purpose during a presidential year and have, therefore, retired from the negotiations. A meeting of the bondholders' committee for the purpose of effecting plans for reorganization of the company will probably be called within a few days, according to a statement issued by W. W. Miller, of Hornblower, Miller & Potter, New York, counsel for the bondholders' committee. Mr. Miller states that the examination of the properties of the Toledo Railways & Light Company by H. M. Byllesby & Company fully demonstrated the value of the properties and their earning power as represented to them, and that the cause of the firm's withdrawal was the unsettled political situation, as stated above. He added that the city interests in Toledo are inclined to be friendly toward the bondholders' committee, and that the fare situation is now being tried out by a plan which will make it possible to determine what rate of fare should be charged in order that proper returns may be obtained upon the amount of capital invested in the property.

Central States Electric Company Organized.—As stated in these columns last week, Harrison Williams, 60 Broadway, New York, has secured control of the Cleveland Electric Illuminating Company. More than 60 per cent of the common stock of the Cleveland company was obtained by him under his offer of $130 per share. In keeping with the plan for acquisition of the Cleveland company, the Central States Electric Company will be incorporated under Virginia laws to take over the stock already deposited. The new company has sold to Spencer Trask & Company $3,730,000 ten-year 5 per cent notes, secured by deposit with a trustee of the $4,403,640 par value of the Cleveland Electric Illuminating common stock acquired. The authorized note issue is $6,000,000 and the balance will be issued as additional Cleveland stock is acquired. In addition to the notes, the Central States company will have an authorized issue of $30,000,000 7 per cent preferred stock, of which $3,000,000 will be issued at once. It will also have at least $10,000,000 common stock, of which $3,600,000 will be issued at once. Other properties will be taken over by the Central States company as opportunity offers.

United Electric Securities (Boston) Offering.—Boston interests are offering, subject to prior sale, $500,000 United Electric Securities Company thirty-sixth series collateral trust 5 per cent bonds, due Feb. 1, 1942, at 100 and interest, and callable at 103 and interest. The company was incorporated in Maine in May, 1890. It reported a surplus on Dec. 31, 1911, of $1,341,180. Dividends at the rate of 7 per cent per annum are paid on $1,000,000 preferred stock. The United Electric Securities Company purchases, after expert examination, mortgage bonds of electric light, railway and power companies and issues against them its own collateral trust bonds, the par value of the underlying securities exceeding by a margin of 25 per cent that of the collateral trust bonds. As opportunities present themselves the company sells these underlying securities and with the proceeds redeems a proportionate amount of its own collateral trust bonds. It has issued, prior to the present offering, thirty-five series, aggregating $20,500,000 of collateral trust bonds, of which $15,097,000 have been retired.

Venezuela Agency for Allied Machinery Company.—Louis R. Scholtz, a mechanical engineer with a broad experience in South American trade, has become the representative of the Allied Machinery Company of America in Venezuela, with offices in Caracas. This company, as previously noted in these columns, was formed last year to sell American machinery to the foreign trade. Captain Godfrey L. Carden, vice-president and general manager of the company, who has been abroad during the past year establishing agencies in various parts of Europe, is now in Paris, where he has been in conference with the president of the company, Samuel McRoberts, vice-president of the National City Bank, New York, who is abroad giving attention to some of the bank's foreign affairs.

Chesapeake & Potomac Telephone to Absorb Diamond State Telephone Company.—Preliminary to the final taking over of the Diamond State Telephone Company, of Dover, Del., by the Chesapeake & Potomac Company, of Baltimore, Md., a petition was filed with the Maryland Public Service Commission last week by the latter company requesting that it be permitted to absorb the smaller concern. The Diamond State company operates mainly on the Eastern Shore of Maryland. It has been for some time a subsidiary of the Bell company, but has retained its identity

as a separate institution. It also operates to a small extent in Delaware and Virginia. All of the stock is now owned by the Bell company, which also owns the Chesapeake & Potomac. The Diamond State company operates about 3,000 telephones over about 1250 miles of wire. Its outstanding capital is $201,000, and its bonded debt is $500,000. The physical amalgamation of the two companies will mean that the headquarters of the smaller one will be merged with those of the Chesapeake & Potomac in Baltimore.

To Decorate Baltimore for Democratic Convention.—Eugene I. Rosenfeld & Company, contractors, of Baltimore, Md., have been awarded a contract by the Baltimore Board of Awards to install fixtures for illumination of various public buildings during the Democratic National Convention to be held in that city next month. The Rosenfeld company's bid was 50 per cent lower than any competitor's, which was due to the fact that it has the fixtures used in previous illuminations of streets and buildings. For $3,850 it has agreed to wire the city hall, court house, Fifth Regiment Armory and the shot tower and to place searchlights on the Maryland Casualty Tower Building, the Emerson Tower and the Belvedere Hotel. As the bid was so much lower than had been expected it is understood that the plans for general illumination will be made more extensive, since an appropriation of $15,000 had been made for this purpose.

Report of Hagerstown (Md.) Municipal Plant.—The Street Commissioners of Hagerstown, Md., have submitted to the Mayor and City Council the annual report of the Hagerstown municipal electric light plant. The receipts last year were $44,033 for energy sold and $933 from taxes. The operating expenses for the year were $31,064, and $8,431 was spent for permanent improvements. Cash on hand at the beginning of the year was $11,342 and cash on hand at the close of the year was $16,813. Estimating the lighting of the streets and alleys by 186 arc lights as being worth to the city $9,300, or $50 per arc light, the management has ascertained the net earnings of the plant for the year to be $14,404. The value of the plant at the close of the year is estimated at $107,873. It was built about eleven years ago.

Competition in Wilmington, Del.—The Public Utilities Light, Heat & Power Company has been incorporated under Delaware laws with a nominal capitalization of $500,000 to supply electric service in Wilmington, Del. The incorporators are associated with the Wilmington Southern Traction Company, which was formerly a part of the Wilmington, New Castle & Southern Railway Company. The new company will be a competitor of the Wilmington & Philadelphia Traction Company, whose rates are higher than those named in the application of the new company, for a franchise to operate in Wilmington. If the franchise is granted the capitalization of the new company will be largely increased.

Appropriation for New Haven Electrification.—Directors of the New York, New Haven & Hartford Railroad have voted to appropriate the $4,000,000 required to cover the expense of electrifying the main line of the road between Stamford and New Haven, Conn., to which reference was made in these columns April 20. Work on the New York, Westchester & Boston Railway, which is a subsidiary of the New Haven and is to be a four-track high-speed electric line, is progressing rapidly. The portion of the road between the temporary station at 180th and Adams Streets and North Avenue, New Rochelle, will be opened to the public on May 29.

United States Light & Heating Company Affairs.—Owing to growth of business, the United States Light & Heating Company is planning to enlarge its plant at Niagara Falls. This plant was completed last May. Orders for the company's new automobile lighting and starting device form a large part of the increased business.

May Deposit McCrum-Howell Stock Until June.—Announcement has been made by the Chicago Title & Trust Company, of Chicago, depositary of McCrum-Howell stocks, that the stockholders' committee for the above company has extended the time in which stock may be deposited to and including June 1.

Columbus (Ohio) Railway & Light Reorganization.—It is expected that a plan for reorganization of the Columbus Railway & Light Company will be presented at a meeting of directors to be held within a short time.

REPORTS OF EARNINGS.

DAYTON POWER & LIGHT COMPANY, DAYTON, OHIO.

The report of the Dayton Power & Light Company, of Dayton, Ohio, for the ten months ended April 30, 1912, compares with that for the ten months ended April 30, 1911, as follows:

	1912.	1911.
Gross earnings, six months ended April 30	$558,276	$508,451
Operating expenses and taxes	293,170	296,061
Net earnings	$265,106	$212,390
Interest receivable	37,894	68
Total net income	$303,000	$212,458
Interest on bonds and notes	168,500	147,304
Uncollectible accounts	2,838	.....
Total deductions	171,338	147,304
Net income	$131,662	$65,154

KINGS COUNTY ELECTRIC LIGHT & POWER COMPANY, BROOKLYN, N. Y.

The combined statement of earnings of the Kings County Electric Light & Power Company and the Edison Electric Illuminating Company of Brooklyn, N. Y., for four months ended April 30, 1912, compares with that for the corresponding period of the previous year as follows:

Four Months Ended April 30:	1912.	1911.
Gross operating revenue	$1,790,293	$1,567,020
Operating expenses, taxes and depreciation	1,090,781	954,754
Net operating revenue	$699,512	$612,265
Other revenue	18,695	20,247
Net income	$718,207	$632,512
Bond discount	6,756	6,756
Bond interest	282,186	252,186
Profit and loss surplus	$429,265	$373,569

PRICES IN THE NEW YORK METAL MARKET.

Copper:

	May 15 Bid.	May 15 Asked.	May 22 Bid.	May 22 Asked.
Standard:				
Spot	15.50	16.00	15.75	16.25
May	15.50	16.00	15.75	16.25
June	15.70	16.00	16.00	16.20
July	15.75	16.00	16.00	16.20
August	15.75	16.00	16.05	16.20
September	....	....	16.07½	16.25
London quotation:	£ s d		£ s d	
Standard copper, spot	71 18 9		73 15 0	
Standard copper, futures	72 7 6		74 2 6	
Prime Lake	16.10 to 16.20		16.50	
Electrolytic	16.00 to 16.10		16.35	
Casting	15.90 to 16.00		16.15	
Copper wire, base	17.00		17.50	
Seamless tubing, copper, base	23.00		23.00	
Seamless tubing, brass, base	20.00		20.00	
Lead	4.20		4.20	
Sheet zinc, f.o.b., smelter	8.65		8.65	
Spelter, spot	6.85		6.92½	
Nickel	39.00 to 40.00		39.00 to 40.00	
Aluminum:				
No. 1 pure ingot	19@22		21@22	
Rods and wire, base	31		31	
Sheets, base	33		33	
OLD METALS.				
Heavy copper and wire	14.25		14.25	
Brass, heavy	10.00		10.00	
Brass, light	8.25		8.25	
Lead, heavy	4.20		4.00	
Zinc scrap	5.75		5.75	

COPPER EXPORTS IN MAY.

Total tons, including, May 15	11,318	May 22,	17,812

STOCK MARKET PRICES.

	May 15.	May 22.
Allis-Chalmers	2	1
Allis-Chalmers, pf.	6*	3½
Amalgamated Copper	83	83
Amer. Tel. & Tel.	146	145¾
Boston Edison	292	289
Commonwealth Edison	144	142
Electric Storage Battery	56⅛	55¾
General Electric	170	167⅞
Mackay Companies	83½*	85⅞*
Mackay Companies, pf.	69	69*
Philadelphia Electric	19⅜	19⅛
Western Union	83⅛	83
Westinghouse	76*	74
Westinghouse, pf.	121*	120*

*Last price quoted.

Personal

Prof. Elihu Thomson has had awarded to him by Franklin Institute an Elliott Cresson gold medal in recognition of his work in the industrial application of electricity.

Mr. Lloyd L. Smith, formerly with the Knox Engineering Company, has accepted a position as electrical engineer with the W. H. Rosecrans Engineering Company of Chicago.

Mr. E. D. V. Dickey, formerly superintendent of the Beloit (Wis.) Water, Gas & Electric Company, has become general manager of the Emporia (Kan.) Electric Light & Gas Company.

Mr. Frank W. Frueauff, past president of the National Electric Light Association and of the National Commercial Gas Association, addressed the "Gas Meeters" in New York on May 24.

Mr. Fred F. Cady, formerly of the Dallas sales office of the General Electric Company, has been appointed new-business manager for the Amarillo (Tex.) Light, Power & Water Company.

Mr. S. B. Harting, for the past twenty years manager of the Elwood (Ind.) Electric Light Company, has retired from this position, to be succeeded by **Mr. N. M. Argalrait,** of Hartford City, Ind.

Prof. Dugald C. Jackson, past president of the American Institute of Electrical Engineers, will start May 28 on a trip to Europe, where he will visit various engineering schools and electrically operated trunk railroads.

Mr. Ernst F. Alexanderson, of Schenectady, N. Y., delivered an address on "Generating Apparatus for Wireless Telegraph and Telephone" at a meeting of the American Society of Swedish Engineers, Brooklyn, on May 18.

Mr. W. J. Massie, who recently resigned as president of the Macon (Ga.) Railway & Light Company and the Central Georgia Power Company, has been instrumental in organizing the Georgia Public Service Company, with headquarters in Macon.

Mr. Dudley Farrand, past president of the National Electric Light Association, was the guest of honor at a banquet given by his official associates in the Public Service Electric Company, Newark, N. J., on May 15, in commemoration of the completion of twenty-five years of service with the company.

Mr. George Williams, manager of the new business department of the Doherty companies, has been stationed at Galveston, Tex., since March of this year, where he is directing an active commercial campaign for the Brush Electric Light & Power Company, a recent acquisition to the Doherty properties.

Mr. Edward W. Bemis, who has been an expert for several cities in the investigation of public-utility questions, has been suggested by the Maryland Public Service Commission, in a recent communication to Governor Goldsborough, for appointment to have charge of the analysis of the situation in Baltimore respecting the Consolidated Gas, Electric Light & Power Company.

Mr. W. H. Merrill, Jr., retiring president of the National Fire Protection Association, was made the recipient of a pair of silver candlesticks at the recent Chicago convention of the association. The presentation was made by Mr. C. M. Goddard on behalf of Mr. Merrill's fellow-members. Mr. Merrill, who has been active in all measures to reduce fire waste, is the manager of the Underwriters' Laboratories of Chicago.

Mr. James D. Mortimer has been transferred from the position of vice-president and general manager to that of president of the Milwaukee Railway & Light Company, to succeed **Mr. James Campbell,** who has been appointed chairman of the board of directors. **Mr. R. B. Stern,** formerly assistant general manager, has been made vice-president, while **Mr. S. B. Way,** formerly assistant general manager in charge of the lighting department, has been appointed vice-president and assistant general manager.

Mr. J. B. Mahoney, formerly superintendent of the Hudson River Electric Power Company at Utica, Albany, Troy and Cohoes, and for the past two years superintendent of the Connecticut River Power Company, of New Hampshire, has been appointed superintendent of power for the New England Power Company, Connecticut River Transmission Company and allied companies. Mr. Mahoney will shortly move his headquarters to Shelburne Falls, Mass., in order to organize the operating forces of the four new plants on the Deerfield River.

Mr. C. M. Goddard, of Boston, for some twenty years secretary of the Underwriters' National Electric Association, was presented with a handsome three-piece silver salver service at the recent Chicago convention of the National Fire Protection Association, which has succeeded the Underwriters' National Electric Association. Mr. F. E. Cabot, of Boston, made the presentation speech, and Mr. W. H. Merrill, of Chicago, remarked that Mr. Goddard had done more than any other one man to insure the success of the National Electrical Code.

Mr. G. E. Williamson, illuminating and sign specialist for the Denver Gas & Electric Company, is making a tour of Eastern cities to study methods of special decoration and display lighting, preparatory to designing the illumination effects for the Knight Templar conclave to be held in Denver in August of next year. **Mr. W. J. Barker,** vice-president and general manager of the Denver company, is chairman of the committee on illumination for the forthcoming conclave, during which it is hoped to surpass all previous attempts at spectacular lighting effects. Before returning from the East Mr. Williamson will visit New York, Baltimore, Atlantic City, Atlanta, New Orleans and Galveston.

Prof. Theodore W. Richards, head of the department of chemistry at Harvard University, was the recipient of the Willard Gibbs gold medal of the Chicago Section of the American Chemical Society at a banquet held at the Hotel Sherman on May 17. The medal, established by Mr. William A. Converse, is awarded in recognition of distinguished work in the science of chemistry, and it bears the name of one of the most noted of American chemists. Dr. Arrhenius, of Stockholm, Sweden, was the first person to receive the medal. Dr. Stone, president of Purdue University, was one of the speakers at the banquet, the presentation being made by Prof. John H. Long, of Northwestern University.

Prof. Vladimir Karapetoff, of Cornell University, will sail on the steamship *Rotterdam* for London on May 28, accompanied by Mrs. Karapetoff. They plan to spend some time in London and Paris and then make a tour of the Continent, sailing from Hamburg on Sept. 7 on the *Cincinnati*, in time for the opening of Cornell University next fall. The academic year 1911-12 was Prof. Karapetoff's sabbatical year, for which he had a leave of absence from the university, spent in the employ of J. G. White & Company, New York, working on some problems in connection with administration and new-business-getting methods. Three books of his appeared in print during this academic year, namely "The Electric Circuit," "The Magnetic Circuit" and "Engineering Applications of Higher Mathematics."

Obituary

Mr. Donald McCormick, chief electrician of the Cunard steamship *Franconia*, died on May 19 at the Relief Hospital in Boston from injuries received on shipboard about ten days before. He was forty-nine years of age and had been in the employ of the Cunard company for twenty-two years.

Mr. Paul de la Cour, chief designer for Bruce, Peebles & Company, Edinburgh, died on May 11, following an operation for appendicitis. He was born in Denmark in the year 1879, and he has thus died at the early age of thirty-three. He was educated at the Technical College, Aarhuus, Denmark, and subsequently at the Technical College of Zurich, Switzerland. In 1901 he was appointed assistant to the late Prof. Engelbert Arnold, of Karlsruhe University, afterward becoming assistant to the chief engineer of the Volta Company at Reval, Russia. In this position he remained until 1905, when he joined the staff of Bruce, Peebles & Company, as chief of the design department, which position he held until his death. Mr. de la Cour is survived by a widow and several children. Mr. J. L. de la Cour, of the General Electric Company of Sweden, is his brother.

Construction

BIRMINGHAM, ALA.—Plans are being considered for extending the ornamental lighting system along Twentieth Street to Five Points and from there along Highland Avenue to the Country Club.

HARTSELLS, ALA.—The installation of a lighting plant, water-works and sewerage systems is contemplated by the city. R. A. Burleson is city engineer.

HUNTSVILLE, ALA.—The property of the Huntsville Ry., Lt. & Pwr. Co., it is reported, will soon be taken over by Eastern capitalists, who, it is said, will make extensions and improvements to the system, at a cost of about $100,000. The extension of the railway to the mountain will be completed and other improvements made.

SYLACAUGA, ALA.—Application has been made to the City Council by the company which is developing electrical power on the Little River, near Gadsden, and the Jackson Shoals, above Talladega.

TALLADEGA, ALA.—The substation of the Alabama Pwr. Devel. Co. on Court Street was destroyed by a cyclone on May 8, causing a loss of from $60,000 to $70,000.

ASHDOWN, ARK.—Municipal improvements are contemplated by the town of Ashdown, including the installation of a light plant, water-works and sewerage systems.

LITTLE ROCK, ARK.—The Garland Pwr. & Devel. Co. is considering plans for the construction of a hydroelectric plant on the Ouachita River. The plant when completed will furnish electricity in Little Rock, Argenta, Hot Springs, Pine Bluff, Malvern and other cities in Arkansas. E. J. Beard, Kansas City, Mo., P. J. Hannan, of St. Louis, and others are interested in the company.

BEAUMONT, CAL.—A group of Los Angeles men headed by L. A. Rogers is contemplating the installation of an electric plant here. A steam laundry may be installed in connection with the lighting plant.

CLAREMONT, CAL.—A bond issue of $100,000 for the purchase and improvement of the property of the Citizens' Lt. & Pwr. Co. is under consideration. Both the water and light systems would be operated by the municipality.

GLENDORA, CAL.—Bids will be received by the Board of Trustees until June 4 for a 50-year franchise to construct and operate transmission line in Glendora.

GREENVILLE, CAL.—The Indian Valley El. Lt. & Pwr. Co. has started preliminary work on a 31,000-hp hydroelectric development on the North Fork of the Feather River. The first unit will develop about 2000 hp and will be available by Oct. 1. A. C. Pratt is president.

HOLLISTER, CAL.—The Sierra & San Francisco Lt. & Pwr. Co. has applied to the Board of County Supervisors for a blanket franchise to extend its transmission lines across the north end of the county. Later a branch line will be extended to Hollister.

LOS ANGELES, CAL.—The city has voted to appropriate $8,000 for the installation of a new police fire-alarm and telegraph system; $150,000 was also voted to extend the municipal lighting system.

LOS ANGELES, CAL.—The City Council has authorized the installation of ornamental street lamps on Sixth Street from Hill Street to San Mateo Street. The city will pay one-eighth of the cost and the property owners on Sixth Street the remainder.

MILL VALLEY, CAL.—The Mill Valley & Mount Tamalpais Scenic Ry. Co. has applied to the State Railroad Commission for permission to issue $150,000 in capital stock. Of the proceeds $50,000 will be used for improvements and for new equipment.

RED BLUFF, CAL.—The Victor Pwr. Co. has increased its capital stock from $250,000 to $500,000. James H. Sharpe and P. H. Coffman are among the directors.

RICHMOND, CAL.—The East Shore & Suburban El. R. R. Co. is planning to erect a substation and carhouse at its terminal in Richmond, to cost about $50,000.

SAN FRANCISCO, CAL.—The Board of Supervisors has decided to purchase electricity to operate the Geary Street railway and will cancel all plans for installing the $70,000 transformer plant in connection with the municipal carhouse. It is expected that the same action will be taken regarding the power plant that was to have been built in the North Beach district, at a cost of $250,000. The Board of Works has been directed to ask for bids for supplying power.

SAN JOSE, CAL.—The Board of Supervisors has adopted a resolution calling for bids for the installation of a lighting system in Pala Orchard and Berryessa precincts.

SANTA ROSA, CAL.—Under the new contract with the Great Western Pwr. Co. the outlying districts will be well lighted. It is proposed to substitute 100-watt tungsten lamps for the present arc lamps throughout the city.

STOCKTON, CAL.—The Stockton El. R.R. Co. is contemplating an extension of its railway from Stockton to Oak Park via Eldorado Street at a cost of about $60,000.

VAN NUYS, CAL.—The Southern California Edison Co. is preparing to supply electricity for lamps and motors in Van Nuys and surrounding country. The company proposes to erect a substation on East C Street.

GILCREST, COL.—The Council has purchased equipment for an electric-light plant to supply electricity for lighting the streets and residences in Gilcrest.

NORWICH, CONN.—Investigations are being made by a special committee of the Norwich Business Men's Association for street-lighting systems in different cities with a view of securing better illuminating system for the business district here.

WATERVILLE, CONN.—The Berbecker & Rowland Mfg. Co. is contemplating the construction of a power plant in connection with its works.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until June 18 for furnishing the following supplies: Schedule 4578—gas-producing apparatus; Schedule 4579—electric spot-welding machine.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until June 18 for furnishing supplies at the various navy yards as follows: Boston, Mass., Schedule 4583—13,000 carbons for arc lamps; Norfolk, Va., Schedule 4590—20,370 ft. lead-sheathed, rubber-insulated lead cable. T. J. Cowie is paymaster-general.

WASHINGTON, D. C.—The American Consul at Montevideo, Uruguay, reports that tenders will be received until June 20 for furnishing and placing electrically operated revolving bridges, weighing 3300 lb. and with 2493 ft. of way, as per conditions on view at the office of Traffic and Conservation of the Port Works Council of Montevideo. For further information address No. 8817, Bureau of Manufactures, Department of Commerce and Labor, Washington, D. C.

NEW SMYRNA, FLA.—John T. Hammond is planning to install an electric-light plant here.

MACON, GA.—The Scofield Engineering Co., Philadelphia, has been retained as consulting engineer by the Georgia Pub. Ser. Corpn., in connection with the construction of a steam power plant in Macon, work on which will begin immediately. The Georgia Pub. Ser. Co. was recently organized with a capital stock of $1,000,000 to supply electricity in Macon and surrounding territory. W. J. Massee, James Anderson and Orville Park are incorporators. The company has awarded contracts for machinery to generate 3000 hp, at a cost of about $180,000.

VALDOSTA, GA.—Plans are being considered by the new owners of the Consol. Ice & Pwr. Co. for extensive improvements to the plant. It is understood that the output of the plant will be doubled and the city rewired throughout. H. T. Hartmen, of Philadelphia, is interested.

AMERICAN FALLS, IDAHO.—The American Falls Pwr. Co. has awarded a contract to the James A. Green Co., constructing engineers, for the construction of a hydroelectric power plant at American Falls, for $250,000. It is said that additions will be decided upon in the next 60 days which will increase the contract to nearly $500,000. The initial installation will provide for a development of 5000 hp. The buildings, raceway and dam will be sufficient to develop 35,000 hp. The work includes the erection of a transmission line from American Falls to Pocatello.

CAMBRIDGE, IDAHO.—Surveys are being made by the Cambridge, Indian Valley & Eastern R. R. Co. for its electric railway from Cambridge through the Indian Valley. The proposed railway will be about 16 miles long. D. Highley, New Meadows, Idaho, is engineer in charge of surveys.

STITES, IDAHO.—The City Council has granted the Kooshia Milling & Pwr. Co. a franchise to erect and operate an electric-light and power plant in Stites.

BLOOMINGTON, ILL.—The Bloomington & Normal Ry. & Lt. Co. has closed a deal whereby it will take over the electric-light plants of the El Paso Lt. & Pwr. Co., El Paso; the Gridley El. Lt. Co., Gridley, and the electric plant at Chenoa, owned by C. C. McDonald. Long-distance transmission lines will be erected from Bloomington to the three towns and electricity furnished from the large plant of the company in Bloomington.

BYRON, ILL.—The Rock River Pwr. Co. is planning to build an electric plant at Byron to cost about $20,000. It is reported that a transmission line will be erected to Freeport and a distributing system erected in that town to supply electricity for lamps and motors. G. M. Clark, Byron, is president and Owen T. Smith, Freeport, vice-president.

CARLINVILLE, ILL.—Negotiations have been concluded whereby the McKinley Syndicate has purchased the gas and electric plants of the Carlin Utilities Co.

CHAMPAIGN, ILL.—Bids will be received until July 1 by the City Council for equipment for new electric-lighting system. Preliminary plans call for 64 lamp standards with underground connection, 331 lamps of 100 cp and 252 60-cp lamps.

DIXON, ILL.—The proposition to extend the franchises of the Lee County Ltg. Co. and the Sterling, Dixon & Eastern Ry. Co. has been approved by the voters. Both systems, it is said, will be absorbed by the Northern Illinois Utilities Co.

GREENVILLE, ILL.—The Greenville El. Lt., Gas & Pwr. Co. is planning to substitute tungsten lamps for the present arc lamps.

HENNING, ILL.—The Village Board has entered into a contract with R. C. Wilson and associates, of Potomac, for lighting the streets of the village. A transmission line will be erected from Potomac to Henning.

JOLIET, ILL.—As a result of an appeal by the Mayor and committee of aldermen the Sanitary District of Chicago has decided to submit a

bid for lighting the streets of the city. If the Sanitary District should obtain the contract, it would be necessary to erect a complete plant or take over the present system.

MARINE, ILL.—The Collinsville El. Lt. & Pwr. Co., Collinsville, has submitted a proposition to the Town Council for the installation of an electric-light system here. A. W. Crawford is vice-president.

PAXTON, ILL.—The Consumers' Ht., Lt. & Pwr. Co. has purchased a site for its proposed new plant in this city. H. L. Clarke is one of the promoters of the new company.

PEORIA, ILL.—A movement has been started by the Uplands Improvement Assoc. for the installation of ornamental lamps on Columbia Terrace, Parkside Drive and Institute Place.

SHEFFIELD, ILL.—The Village Board has granted Byron Harpole a 30-year franchise to construct and operate an electric-light plant here.

SPRING VALLEY, ILL.—The installation of a boulevard lighting system on St. Paul Street is proposed.

WINDSOR, ILL.—The City Council has granted an electric-light franchise and street-lighting contract to H. E. Munson, J. H. Wallace and A. C. Crays, of Windsor.

WYOMING, ILL.—E. B. Hillman, owner of the local electric-light plant, has applied to the City Council for a 20-year extension of his electric-light franchise with a view of installing additional equipment and furnishing a 24-hour service.

ALEXANDRIA, IND.—The installation of an electric-lighting system in the Scott addition, a suburb of Alexandria, is under consideration.

LAFAYETTE, IND.—The capital stock of the Merchants' El. Lt. Assoc. has been increased from $200,000 to $350,000, the proceeds to be used for extension and improvements to the plant. P. A. Byers is president.

LAPEL, IND.—The Town Board has awarded the Noblesville Ht., Lt. & Pwr Co., Noblesville, a contract for lighting the town by electricity. The street-lighting contract calls for 36 tungsten lamps.

CEDAR FALLS, IA.—The installation of an ornamental street-lighting system in the business section is under consideration.

CHEROKEE, IA.—The electric plant of the Cherokee El. Co. has been sold to A. A. Boyd and W. E. Wright, Michigan City, Ind. The new owners propose to establish a day service and make other improvements to the system.

CRESTON, IA.—The Creston Gas & El. Co. has increased its capital stock from $100,000 to $160,000.

MAQUOKETA, IA.—The Barnes El. Lt. & Pwr. Co. is enlarging its power house and will install an additional generator and two new boilers. A new transmission line to Anamosa is being erected.

ORANGE CITY, IA.—F. W. Michel, who was recently granted a 20-year franchise, has purchased the local electric-light plant, owned by Harry Kooyman.

WATERLOO, IA.—A power house of the Waterloo, Cedar Falls & Northern Ry. Co. was recently destroyed by fire, causing a loss of about $125,000. The new power house of the company was not damaged.

FRONTENAC, KAN.—It has been decided to equip the new pumping station with two electric-motor-driven pumps.

HALSTEAD, KAN.—The Wichita Pwr. & El. Co. has extended its transmission lines to Halstead and will soon supply electrical service there. Electric street lamps will be placed on Main Street later.

IOLA, KAN.—The installation of additional equipment in the municipal electric-light plant is under consideration.

OSAWATOMIE, KAN.—Bonds to the amount of $20,000 have been voted for the construction of a municipal electric-light plant and other municipal improvements.

SALINA, KAN.—Plans are being considered for the installation of ornamental lamp standards, carrying five-lamp clusters, on Santa Fe and Iron Avenues and Ash Street. Frank Ekstrand has charge of the proposition.

BARBOURVILLE, KY.—The property and franchise of the Barbourville Lt. & Pwr. Co. has been purchased by G. W. Tye and A. D. Smith, Barbourville. Improvements and extensions will be made to the system.

HARLAN, KY.—The Harlan Coal Mining Co., of Louisville, has awarded a contract to the Morgan-Gardner El. Co., of Chicago, for the installation of a power plant and mining equipment for its new coal fields now being opened for development near Harlan. The equipment will include boilers manufactured by the Skinner Mfg. Co., Pittsburgh, and generator made by the James Clark, Jr., El. Co., Louisville.

LOUISVILLE, KY.—The Interstate Pwr. Co., recently incorporated with a capital stock of $500,000, has the contract for the distribution of electricity generated by the Tennessee Pwr. Co. in Northern Georgia.

CAMBRIDGE, MD.—The property of the Cambridge Gas & El. Lt. & Pwr. Co. has been purchased by Gustavo Lobo, of Galban & Co., engineers, New York, N. Y. E. C. Carrington, Baltimore, is president of the Cambridge company.

SYKESVILLE, MD.—The installation of an electric-light system is under consideration by the town. D. B. Sprecher is Mayor.

BROOKFIELD, MASS.—The Central Massachusetts El. Co. has been granted a franchise by the Selectmen to erect transmission lines here to supply electricity for lamps and motors.

HARVARD, MASS.—The Selectmen have granted the Harvard Gas & El. Co. permission to supply electricity for lamps, heat and motors here. Plans are being prepared by the Light, Ht. & Pwr. Corpn., of Boston, for the distributing system. For the present the company will purchase energy from the Ayer El. Lt. Co., Ayer. Electrical service will be furnished by the company in Harvard Center, Still River, Oak Hill, Prospect Hill and other towns. The company expects eventually to build a power plant at Still River. Lester E. Whitcomb, superintendent of the Ayer El. Lt. Co., will have charge of the business of the Harvard company.

HINSDALE, MASS.—Messrs. Sargent & Munch, Pittsfield, have applied for a franchise to establish an electric-light plant here.

LAWRENCE, MASS.—Plans have been prepared by the Lawrence Gas Co. for an addition to its electric power house on St. Lawrence Street to cost approximately $20,000; also an addition to the repair shop on Methuen Street to cost $3,000.

LONGMEADOW, MASS.—At a special town meeting held May 14 the United El. Lt. Co. was granted a franchise to erect transmission lines through the town from Springfield to the State Line on the iron poles of the telephone company until such time as the wires shall be placed underground. The company agrees to place its wires underground within certain limits from Ely Road to Birnie Road within three years, and from the Birnie Road to the State Line within eight years.

LOWELL, MASS.—The Lowell El. Lt. Corpn. has submitted plans for the installation of an ornamental street-lighting system in the business district.

NEW BEDFORD, MASS.—Westinghouse, Church, Kerr & Co., Pittsburgh, are preparing plans for the construction of a substation for the New Bedford Gas & Edison Lt. Co.

PALMER, MASS.—The Selectmen have decided to contract with the Central Massachusetts El. Co. for street lighting. The present arc lamps will be discarded and incandescent lamps installed.

COMSTOCK, MICH.—The Commonwealth Pwr. Co., Jackson, has been granted a 30-year franchise to supply electricity here.

EVART, MICH.—The Evart Lt. & Pwr. Co. has been granted a 30-year franchise by the Town Council. The company will soon begin work on construction of its dam and will rewire the town. The equipment of the municipal electric-light plant will be sold and electric motors installed to operate the pumps. In consideration of the franchise the company has agreed to furnish power to any new manufacturing enterprise starting in Evart for a period of six months.

GROSSE POINTE, MICH.—Steps have been taken by the Village Trustees for the installation of 40 street lamps on Jefferson Avenue between the city limits and the Cadieux road.

HOLLY, MICH.—The Commonwealth Pwr. Co. has purchased the electric plant of the Holly Ltg. Co. The Commonwealth company is negotiating with the Fenton Council to secure the right of way for its high-tension transmission line to connect the Holly plant with Linden. It is proposed to install substation in Fenton to furnish electricity there.

LANSING, MICH.—The State Railroad Commission of Michigan has approved the articles of incorporation of the Peninsula Pwr. Co., of Madison, Wis., and has given it permission to incorporate under the laws of the State of Michigan, as well as to issue $1,000,000 in bonds. The company has been incorporated in Wisconsin with a capital stock of $850,000. It proposes to construct a dam and build a hydroelectric power plant on the Menomonie River. W. E. Mead, dean of the engineering department of the University of Wisconsin, is general manager and chief engineer of the company.

OLIVET, MICH.—The Common Council has granted the Commonwealth Pwr. Co. a 30-year franchise to operate an electric system here subject to the approval of the voters.

PIGEON, MICH.—The proposition to issue $8,000 in bonds for the installation of a municipal electric-light plant will be submitted to the voters.

REED CITY, MICH.—Contract has been awarded by the Osceolo Lt. & Pwr. Co. to the Fargo Constr. Co., Jackson, for the construction of a new dam to replace the one recently destroyed by the flood, at a cost of $6,600. At present the city is without electrical service.

REED CITY, MICH.—The Osceola Lt. & Pwr. Co., Reed City, and the Evart Lt. & Pwr. Co. have applied to the City Council for a franchise to supply electricity here. The Evart company has asked for a 30-year franchise and agrees to build a dam above Hersey on the Muskegon River and to furnish service by Feb. 11, 1913. The Osceola company agrees to have its plant in operation within 90 days. The town has been without electrical service ever since the dam of the Osceola company was carried away by the flood.

TRAVERSE CITY, MICH.—At a special election held May 14 the proposition to issue $150,000 in bonds for the purpose of purchasing the property of the Queen City El. Lt. & Pwr. Co. was carried. A similar election was held March 28 but was declared illegal.

COLERAINE, MINN.—Bids will be received by W. W. Hunter, clerk, until June 15 for a new street-lighting system. The plans call for 48 12-ft. posts.

DULUTH, MINN.—Steps have been taken for the installation of an ornamental street-lighting system in the West End. The cost of erecting the standards is estimated at about $5,000.

HIBBING, MINN.—The Virginia El. Pwr. & Wtr. Co. has decided to

make extensive improvements and additions to the local plant, involving an expenditure of from $40,000 to $50,000.

IRONTON, MINN.—The Cuyanna Range Pwr. & Lt. Co. has been granted a franchise in Ironton.

LESUEUR CENTER, MINN.—W. T. McCaskey & Co., Lansing, Mich., contemplate erecting an electric-light plant here if sufficient patronage can be secured to warrant the expenditure.

NORTH ST. PAUL, MINN.—The City Council is contemplating the installation of a new electric light and power plant.

ROCHESTER, MINN.—The Public Utility Board is having plans prepared for an addition to the power house of the municipal electric-light plant.

BETHANY, MO.—The proposition to issue bonds to the amount of $25,000 for the installation of a new municipal electric-light plant and water-works system will be submitted to a vote.

LAMAR, MO.—The city has purchased the plant of the Lamar Lt. & Wtr. Co. for $30,000 and will make improvements and extensions to the system, at a cost of about $40,000.

SPRINGFIELD, MO.—Improvements costing $443,000 will be made at once to the properties of the Springfield Trac. Co. and the Springfield Gas & El. Co. The proposed work will include the rebuilding of the tracks and trolley lines of the railway company at a cost of $250,000; the extension of the light and power transmission cables, $50,000; building of substation at the local power house, $125,000, and the extension of gas mains and service, $18,000.

CUT BANK, MONT.—It is reported that an electric light and water company of Cœur d'Alene, Idaho, has applied to the City Council for a franchise to install and operate an electric-light plant and water-works system here.

CEDAR BLUFFS, NEB.—Preparations are being made for the construction of a municipal electric-light plant, bids for which will be received in about 30 days. The cost of the work is estimated at about $7,000. The Alamo Engine & Supply Co., Omaha, Neb., has charge of the work.

FARMINGTON, N. H.—The Cloutman Gas & El. Co. has awarded a contract to the General El. Co. for two steam turbo-generators, which will increase the output of the plant to about 500 hp. The company has recently contracted to furnish electricity for lamps at Alton and Alton Bay and to residences along the line between Farmington and Alton. It has also closed a contract with the Thayer-Osborne Shoe Co. to furnish energy for lamps and motors for the factory.

TILTON, N. H.—The Public Service Commission has granted the Tilton El. Lt. & Pwr. Co. permission to increase its capital stock by $14,000.

NEWARK, N. J.—The Public Service El. Co. is planning to erect a brick substation on Fenwick Street, to cost about $11,000.

RAHWAY, N. J.—The question of establishing a municipal electric-light plant in Rahway is under consideration.

ALBUQUERQUE, N. M.—The Albuquerque Gas, El. Lt. & Pwr. Co. has submitted a proposition offering to install an ornamental lighting system on Central Avenue in the business district. The company also offers to erect the lamp standards, each carrying three lamps, at an expense of about $4,000, provided the city pays for the installation of the conduits for same; also to furnish electricity for maintaining same with midnight service at the rate of 10 cents per front foot per month.

GATES, N. Y.—The Town Board has awarded the Rochester Ry. & Lt. Co. a contract for lighting the streets of the town. Work will begin at once on the installation of the system.

GRANVILLE, N. Y.—The Public Service Commission has authorized the Granville El. & Gas Co. to execute a mortgage to secure $400,000 in bonds and to issue thereunder bonds to the amount of $200,000, of which the proceeds of $150,000 are to be used to take up underlying bonds and the remaining $50,000 to be sold at not less than 95, the proceeds of $14,563 to be used for new construction and the remainder for refunding liabilities shown by the company's books.

HEUVELTON, N. Y.—The new lighting district in Heuvelton has been estabished and a committee appointed to draw up a contract under which bids will be asked for lighting the village.

HOLLEY, N. Y.—The Village Board is considering the question of purchasing electricity from the A. L. Swett El. Lt. & Pwr. Co., Medina, to operate the municipal electric-light plant.

LONG LAKE, N. Y.—The Long Lake Lt., Ht. & Pwr. Co. has applied to the Public Service Commission for permission to construct an electric-light plant in Long Lake and also for authority to issue $8,000 in capital stock, the proceeds to be used for construction of a plant. The company expects later to operate at Indian Lake.

LYONS, N. Y.—At an election held May 14 the proposition to issue $10,000 in bonds for the installation of a municipal electric-light plant was carried.

MARCELLUS, N. Y.—F. W. Knapp, owner of the local electric-light plant, has closed a contract with the Syracuse Ltg. Co., Syracuse, for Niagara power and has also purchased poles for the transmission line from Camillus. Mr. Knapp is negotiating with the town of Auburn to supply electrical service there and may also submit a bid to furnish electricity in Skaneateles. The plants of the Onondaga Paper Co., the Lawless paper mills, the Marcellus Paper Co. and Allen & Smith's barley mills will use Niagara power.

MECHANICSVILLE, N. Y.—The Village Trustees are considering the question of changing the motive power at the pumping station from steam to electricity. The Halfmoon Lt., Ht. & Pwr. Co. has submitted a proposition offering to supply electricity for the pumping station on a five-year or ten-year contract at a cost of $12 per day. The company also offers to maintain repairs to the pump, build nearly one-third of the transmission line, operate the filter beds, and to deliver 500,000 gal. of water each 24 hours against 430,000 gal. delivered by the present steam system.

MIDDLETOWN, N. Y.—The Council has adopted a resolution providing for the installation of a new lighting system for James Street.

NEW ROCKFORD, N. Y.—Bids will be received by R. S. Craig, county auditor, until June 10 for a lighting plant for the court house.

NEW YORK, N. Y.—Proposals will be received at the office of the general storekeeper of supplies, United States Custom House, New York, until May 31 for electrical supplies and miscellaneous supplies for the United States public buildings in New York City and Brooklyn for the fiscal year 1913. Copies of specifications and proposal form may be obtained on application to Francis Kaley, general storekeeper of supplies.

OGDENSBURG, N. Y.—The new factory of the Newell Mfg. Co., to be erected on Depot Hill, will be operated throughout by electricity furnished by the Hannawa Falls Wtr. Pwr. Co.

OLEAN, N. Y.—Plans and specifications are being prepared for the construction of the new power plant for the Western New York & Pennsylvania Trac. Co. in Olean, to cost about $250,000. The plans provide for an initial installation of a 750-hp turbine direct-connected to a generator with space for a second unit of the same rating within a year. Three Babcock & Wilcox boilers will be installed. The building will be 176 ft. x 160 ft.

OSWEGO, N. Y.—A committee has been appointed by the Retail Merchants' Association to make further investigations pertaining to the installation of an ornamental lighting system in the business district. The committee appointed to investigate the matter reported that the cost would be about $8,000, of which the city would pay one-third.

PHILMONT, N. Y.—The question of changing the street-lighting system from gas to electricity is under consideration. The Red Hook Lt. & Pwr. Co. has submitted a proposition to the town officials to furnish the service. Two other companies are also anxious to secure franchises.

SODUS, N. Y.—The Wayne Pwr. Co. is planning to extend its service to many towns, including Avoca, Wallace, Cohocton, Atlanta, North Cohocton and Naples and will probably extend the lines to Bath and Dansville, making Wayland a central distributing point. The company expects to secure power from Niagara Falls. The nearest point at which the main line can be tapped is about 25 miles from the proposed lines of the Wayne company. The cost of the transmission lines is estimated at $50,000 and that of the substation from $75,000 to $100,000. G. R. Mills, Sodus, is president of the company.

SYRACUSE, N. Y.—The Syracuse & South Bay El. Ry. Co. will award contracts for the construction of about 6 miles of tracks in the near future.

BANNERS ELK, N. C.—Steps have been taken for the installation of a small hydroelectric light plant for the Lees-McRae Institute at Banners Elk. A survey has been made of the water-power site on the Elk River, a short distance from the institute, where it is estimated that 80 hp can be developed. The cost of the plant complete is estimated at $5,000.

NORTHWOOD, N. D.—The installation of an electric-light plant in Northwood is under consideration.

AKRON, OHIO.—The Northern Ohio Trac. & Lt. Co. has decided to issue $1,640,000 in capital stock, the proceeds to be used to construct a new central power station, reconstruct lines and other work, amounting in all to about $2,000,000.

CINCINNATI, OHIO.—Bids will be received until June 4 by the Board of Public Safety for furnishing underground cables for signal and telephone circuits of the Fire Department.

DAYTON, OHIO.—The Board of Education has decided to install an independent lighting and power plant in the manual training school addition to Stivers High School.

LOWELLVILLE, OHIO.—Preparations are being made for the construction of a new power station in Lowellville for the Republic Ry. & Lt. Co., which controls all the railways formerly controlled by the Mahoning and Shenango Ry. & Lt. Co., Youngstown. The Stone & Webster Engineering Corpn. has the contract for the work. H. L. Patterson is chief engineer of the railway company and Edward A. Lake is consulting engineer for the Stone & Webster Corpn.

PORT CLINTON, OHIO.—The American Gypsum Co. is planning to erect an electric power house at its plant 2 miles east of the city.

SALEM, OHIO.—The Council has adopted specifications for the new lighting system and has passed an ordinance authorizing the Director of Public Service to advertise for bids for the installation of same. The plans have been changed so as to bring the cost within $20,000. Concrete posts may be used instead of wooden and bids will be taken on both kinds.

STEUBENVILLE, OHIO.—A proposition has been submitted to the

City Council by G. H. Westfall, Pittsburgh, Pa., for the installation of an electric-light plant here. Mr. Westfall states that a company composed of Pittsburgh men, including himself, if granted a franchise, will establish an electric plant in Steubenville, at a cost of $300,000, to supply electricity to private consumers and for manufacturing purposes.

YOUNGSTOWN, OHIO.—The City Council has voted to recommend a bond issue of $30,600 for the installation of a municipal e'ectric-light plant in the basement of the market house to supply electricity to maintain 150 pedestal lamps in the business district.

PAULS VALLEY, OKLA.—W. B. Walker, president, writes that his company will rebuild its dam across the Washita River as soon as the steam plant now in course of construction is completed. The company expects to be able to supply electricity for lamps and motors about July 1. The cost of the work is estimated at about $25,000. H. Walker is engineer in charge.

PONCA, OKLA.—Preparations are being made for the construction of a municipal electric-light plant, bids for which will be opened June 3. The cost of the work is estimated at about $30,000. Burns & McDonnell, Kansas City, Mo., are engineers.

TECUMSEH, OKLA.—The Rapid Transit Interurban Co., which proposes to build an interurban railway from Muskogee through Tecumseh to Chickasha, with a cross line through Tecumseh from Guthrie to Sulphur, is considering a plan to supply electrical energy to the towns and farmers along the route for lamps and motors. It is proposed to build a power plant in Sulphur and Tecumseh and at other points along the system. The company has been granted right-of-way through the counties of Pottawatomie and Murray and street car privileges in Sulphur and Tecumseh and also at Stratford, where a bonus of $10,000 has been raised. Tecumseh has granted a bonus of $20,000 and Sulphur one of $40,000. A bill is pending in Congress granting right-of-way through the National Platte Park at Sulphur.

CORVALLIS, ORE.—Arrangements are being made by the Portland, Eugene & Eastern Ry. Co. for the construction of the local street railway. Orders have been placed for rails and electric equipment and machinery will soon be purchased. George D. O'Connor is manager.

EUGENE, ORE.—The Oregon El. Ry. Co. has awarded the contract for the construction of two large substations, one near Harrisburg and the other near Eugene, to T. H. Ellis, of Eugene.

GRANT'S PASS, ORE.—A special election will soon be held to vote on the proposition to issue bonds for the construction of an electric-light plant and water-works system.

MARSHFIELD, ORE.—The C. A. Smith Lumber & Mfg. Co. has awarded the contract for the erection of a large electric power plant to C. C. Moore & Co., San Francisco, Cal. The equipment will be furnished by the General El. Co. The plant will develop about 3500 hp and will supply electricity for operating part of the sawmill, the paper-pulp plant and to supply power for logging.

SALEM, ORE.—The McKenzie Valley Irrig. & Pwr. Co. has filed on water rights covering 475 second ft. of headwaters of the McKenzie River, under a head of 820 ft.

SALEM, ORE.—Water rights have been filed by the Hill interests in the Willamette Valley on the McKenzie River, near Clear Lake, which will be developed to supply electricity to operate their lines and also to supply electricity for industrial purposes along the Hill lines. The water rights cover 475 second ft. under a head of 820 ft. The plant will have an ultimate output of 25,000 kw.

WALDPORT, ORE.—The City Council has granted a franchise for the installation of a small electric-light plant here.

BUTLER, PA.—The Butler County Lt. Co. has made arrangements to secure electricity from the plant of the Pittsburgh & Butler St. Ry. Co. The new company is planning to erect a new substation in West View Street and expects to be ready to supply electrical service here in September.

DUNLO, PA.—Steps have been taken by the Dunlo Lt., Ht. & Pwr. Co. for the erection of a transmission line from here to Lovett, a distance of 7 miles, to supply electrical service in that town.

ERIE, PA.—The Council has adopted an ordinance authorizing the sale of $15,000 in bonds for installing underground conduits for electric wires in Parade Street and other streets.

EPHRATA, PA.—Bids will be received by the Mayor and the Council until June 3 for one 375-kva non-condensing steam turbine unit, with necessary exciter and switchboard, in accordance with specifications, which can be obtained on application to T. C. Reddig, borough secretary.

LOCK HAVEN, PA.—Proposals will be received by the City Council until May 29 for lighting the streets of the city with not less than 100 arc lamps and from 10 to 25 tungsten lamps for periods of one, three and five years. C. E. Oberheim is city clerk.

MANAYUNK, PA.—The installation of a new street-lighting system here is under consideration and plans are being prepared.

PITTSBURGH, PA.—The City Council is considering the proposition of building a street-car line around Schenley Park. It is estimated that about 3½ miles of track will be required.

SOUDERTON, PA.—A movement has been started to change the street-lighting system from arc lamps to incandescents.

CAMDEN, S. C.—The proposition to issue $100,000 in bonds for the construction of light and water plants or purchase of the present systems will be submitted to a vote.

CHERAW, S. C.—The Yadkin Valley Pwr. Co. has taken over the municipal electric-light plant, for which it paid the town $10,000. The company is preparing to erect a transmission line from Blewitt Falls to Cheraw. As soon as the line is completed a 24-hour service will be established.

GARRETSON, S. D.—At an election to be held June 4 the proposition to issue bonds for the installation of an electric-light plant will be submitted to a vote.

CHATTANOOGA, TENN.—The Chattanooga Ry. & Lt. Co. contemplates improvements to its system, involving an expenditure of about $250,000.

CHATTANOOGA, TENN.—The Tennessee Pwr. Co. has applied to the Council for a 40-year franchise for placing its wires and conduits across certain streets and alleys in the city.

KNOXVILLE, TENN.—The City Commission has granted the Cumberland Tel. & Teleg. Co. permission to place its wires in underground conduits in the business district. The commissioners have decided that all wires must be placed underground in the business section of the city.

SYLVAN BEACH, TEX.—William C. Clark, Detroit, Mich., and associates are interested in a project to build an electric-light and power plant with transmission lines to La Porte, Bay Ridge and Morgan's Point. A franchise has already been secured.

EPHRATA, WASH.—Application has been made to the Council by Seattle parties to operate an electric light and power plant here. It is proposed to install a 300-hp plant and supply electricity for irrigating purposes in Ephrata and at Soap Lake and Naylor.

SEATTLE, WASH.—The City Council has passed an ordinance authorizing the lighting department to make further repairs to the Cedar River dam at a cost of $25,000.

EAU CLAIRE, WIS.—Work will begin on the substation of the Chippewa Valley Ry., Lt. & Pwr. Co., to be located above the Madison Street bridge, as soon as the water subsides in the river.

BASSANO, ALTA, CAN.—Sealed bids will be received by S. E. Whiting, president of the Bassano El. Pwr. & Trac. Co., Bassano, until June 3 for furnishing and installing the following equipment: Section A—two return tubular steam boilers; Section B—one steam engine; Section C—one electric generator and equipment. Specifications may be obtained from S. E. Whiting, president, Bassano, or from Bowring & Logan, engineers, 322 Donald Street, Winnipeg.

MEDICINE HAT, ALTA, CAN.—A by-law will be submitted to the ratepayers on June 3 calling for an expenditure of $50,000 for improvements to the electric-light system and $75,000 for extension to the gas system.

EBURNE, B. C., CAN.—The business men on Fourth Street have petitioned the Council to erect 18 ornamental lamp standards. They offer to bear the cost of installation and maintenance of the lamps.

VANCOUVER, B. C., CAN.—The erection of a telephone line from Vancouver to the Powell River is under consideration by the British Columbia Shipowners' Association.

VERNON, B. C., CAN.—A by-law appropriating $40,000 for construction of new power house and extension to present power plant has been voted.

VERNON, B. C., CAN.—Tenders will be received by D. G. Tate, city clerk, until June 10 for one 125-kw, three-phase, 60-cycle generator with exciter direct-connected, one five-panel switchboard, series tungsten or arc-lighting system. Mather, Yuill & Co., Ltd., Vancouver, B. C., are consulting engineers.

HAMILTON, ONT., CAN.—The Dominion Pwr. & Trans. Co. has decided to build a third transmission line from DeCews Falls to Hamilton. The line will be erected along the mountain top on private right-of-way. The cost of the line is estimated at between $300,000 and $400,000.

HAMILTON, ONT., CAN.—Bids will be received by George H. Lees, Mayor, until May 29 for the construction of an electric station at 50 Hughson Street, plans and specification for which may be seen at the office of the Hamilton Hydro-Electric Department, City Hall. E. I. Sifton is consulting engineer.

OTTAWA, ONT., CAN.—The Ottawa El. Ry. Co. has notified the City Council that it has decided to make several extensions to its lines in this city.

SARNIA, ONT., CAN.—The Town Council is contemplating the installation of electrically operated pumps at the municipal pumping station, at a cost of about $50,000.

ST. THOMAS, ONT., CAN.—The ratepayers have voted in favor of two by-laws, one appropriating $23,500 for improvement to the railway, for equipment and for purchase of three cars; the other to extend the lines on Ross and William Streets.

TORONTO, ONT., CAN.—The Toronto El. Pwr. Co. will begin work at once on the erection of a duplicate transmission line from Niagara Falls to Toronto. Separate towers will be erected for the new line. The cost of the work is estimated at about $500,000.

TORONTO, ONT., CAN.—The Hydro-Electric Commission is planning to extend its transmission lines to Midland and Penetanguishene, taking

in Barrie, Stayner, Collingwood, Coldwater and Elmvale. Preliminary estimates have been submitted to these towns to supply power under a contract between the commission and the Simcoe Ry. & Pwr. Co. at the Big Chute Falls on the Severn River. By-laws will be submitted to the ratepayers in Barrie and Coldwater on June 3 and 7. Work will soon begin on the erection of the line in the Dundas district and steady progress is being made for the extension of the power system into Bruce, Huron and Grey by the utilization of the falls on the Maitland and Saugeen Rivers. Contracts for material for transmission line have been awarded.

BEAUPRE, QUE., CAN.—The Stadacona Pwr. Co., located near Beaupré, has closed a contract with the Ambursen Hydraulic Co., Montreal, for the construction of a power house in connection with the dam which it is now building. The power-house equipment will operate under a head of about 700 ft., the water being conducted to it through about 1500 ft. of penstocks.

REGINA, SASK., CAN.—Plans are being considered for the purchase of new equipment for the municipal electric-light plant during the coming year. Arrangements have been made for the purchase of another street railway unit, and another large generating unit for the lighting system will be installed early in 1913.

WEYBURN, SASK., CAN.—The Town Council is contemplating extensions to the distributing and street-lighting system of the municipal electric-light plant.

MEXICO CITY, MEX.—Patricio McLane has applied to the federal government for a concession to establish a hydroelectric plant on the Valles River in the State of San Luis Potosi.

New Industrial Companies

THE BUFFALO ELECTRIC SHOP, INC., of Buffalo, N. Y., has been granted a charter with a capital stock of $50,000 to do a general contracting business. The incorporators are: Louis W. Wipperman, Edward R. Flack, John Hora, Jr., Edward Southhall and D. M. Tefft.

THE ECONOMY ELECTRIC SIGN COMPANY, of Chicago, Ill., has been granted a charter with a capital stock of $50,000 to manufacture and deal in signs of all kinds. The incorporators are: W. B. and J. C. Cooley and Roderick W. McKinnon.

THE ELECTRIC LAUNDRY EQUIPMENT COMPANY, of Cincinnati, Ohio, has been incorporated by R. D. Robinson, D. McKenzie, T. E. Underwood, W. H. Sharp and J. K. Henry. The company is capitalized at $50,000 and proposes to manufacture and deal in laundry, cleaning and dyeing equipment.

THE ELECTRICAL NOVELTY COMPANY, of Cleveland, Ohio, has been incorporated by Thomas J. Sheftall, Jr., John C. Temple, George R. Brown and J. F. James. The company is capitalized at $10,000 and proposes to deal in electrical novelties.

THE FORT PLAIN ELECTRICAL PIANO COMPANY, of Fort Plain, N. Y., has been organized to manufacture electric player-pianos. The officers of the company are: John M. Yordon, president; John Barker, secretary and manager.

THE HAYRE ELECTRIC COMPANY, of Chicago, Ill., has been chartered with a capital stock of $2,000 for the purpose of manufacturing and dealing in electrical appliances. The incorporators are: I. S. Blumenthal, Maurice Alschuler and C. C. Brosius.

THE HIGH-TENSION ENGINEERING COMPANY, of Philadelphia, Pa., has taken out a Pennsylvania charter for the purpose of manufacturing and selling electrical machinery and apparatus covered by the Smith patents. The incorporators are: Franklin S. Smith, R. M. Vankerchen and Alexander Rennick.

THE SPLITDORF ELECTRICAL COMPANY, of Newark, N. J., has been incorporated with a capital stock of $3,500,000 by J. F. Alvord, Torrington, Conn.; J. Splitdorf, J. R. Villes, C. W. Curais, of New York, N. Y., and B. S. Keeler, of Orange. The company proposes to manufacture ignition and lighting devices. Mr. Alvord is president.

THE WILLISTON ELECTRIC CONSTRUCTION COMPANY, of Williston, N. D., has been incorporated with a capital stock of $25,000 for the purpose of carrying on a general electrical construction business and installing and operating power plants. The incorporators are: Sidney J. Dorothy, Elmore C. McCall and William C. Tatem, of Williston, and George H. Moellring and W. W. Wirtz, Ray.

New Incorporations

LOS ANGELES, CAL.—The Olston El. Co. has been incorporated with a capital stock of $100,000 by R. A. Whitney, C. A. Aldrich, K. Olston and O. Olston.

LOS ANGELES, CAL.—The Olston El. Co. has been granted a charter with a capital stock of $100,000. The incorporators are: R. A. Whitney, Otto Olston and Charles C. Aldrich.

WILLOWS, CAL.—The Sacramento Valley West Side El. Ry. Co. has been incorporated with a capital stock of $5,000,000 to build an electric railway, 160 miles in length, to connect Woodland, Willows, Orland, Corning and Red Bluff, with several branch lines, one from Yolo through Davisville and Dixon to connect with the Oakland, Antioch & Eastern Ry. on the Sacramento River, a distance of 36 miles, another to begin at Colusa and extend through Williams and meet the main line from Red Bluff, a distance of 7 miles. The directors are: C. L. Donohue, L. P. Klemmer, H. W. Manor, Willows; E. L. Sisson, Red Bluff, and J. Reith, Jr., Willows.

WILMINGTON, DEL.—The Pub. Utilities Lt., Ht. & Pwr. Co. has been organized by interests identified with the Wilmington Southern Trac. Co., which operates a traction line between Wilmington and New Castle. The company is capitalized at $500,000 and will be operated in connection with the traction company. The Public Utilities company has applied for a franchise to supply electricity for lamps and motors at Wilmington.

CHICAGO, ILL.—The Rural Public Ser. Co., of Chicago, has been incorporated with a capital stock of $50,000 for the purpose of furnishing electricity, gas and other motive power. The incorporators are: Leroy and William Forkell and Fred B. Silsbee.

CHICAGO, ILL.—The Illinois Public Ser. Co. has been incorporated with a capital stock of $1,000 by Gerard E. Connor, Charles E. Loy and Edwin D. Lawler. The company proposes to operate steam plants, power plants, telephone and telegraph lines and other utilities.

DEER RIVER, MINN.—The Everton El. Lt. & Pwr. Co. has been incorporated with a capital stock of $50,000 by Warren A. Everton, L. B. Everton and Leonard Scott, all of Deer River.

MORA, N. M.—The Mora Lt. & Pwr. Co. has been incorporated by Joseph J. Fuss, Cleveland; J. Franklin Hornig, Las Vegas, and Henry M. Shaw. The company is capitalized at $5,000 and proposes to do a general electric light and power business.

RIPLEY, N. Y.—The Ripley El. Co. has been granted a charter with a capital stock of $3,500. The directors are: Nathan J. Horton, John M. Wethy, J. Watson-Burrows, Robert G. Hildred, Frederick N. Randal and others.

BURLINGTON, N. C.—The Alamance Pwr. Co. has been organized with a capital stock of $300,000 for the purpose of developing the water-power at River Falls on the Haw River, near Burlington. The officers of the company are: F. L. Williamson, Burlington, president and treasurer; J. Harvey White, Graham, vice-president, and Charles E. Menefee, Burlington, secretary.

BERTHOLD, N. D.—The Berthold Farmers' Tel. Co. has been granted a charter with a capital stock of $50,000. William W. Wixer, G. A. Luke and others are directors.

LAWTON, OKLA.—The Lawton Ry. & Lt. Co. has been incorporated with a capital stock of $375,000 by B. R. Stephens, W. H. Fuller, R. L. Scheig, B. W. Hilgard and B. E. Tabler, all of McAlester. The company proposes to build an electric railway from Lawton to Medicine Park, a distance of 16 miles.

McALESTER, OKLA.—The Cole El. Pwr. Co. has been incorporated with a capital stock of $25,000 by Rogers L. Cole, Preslie B. Cole and B. M. Cole.

HARRISBURG, PA.—Charters have been granted by the State Department to the West Chester County El. Co. to furnish electricity in Sadsbury Township and to the Atglen El. Co. to supply the borough of Atglen with electrical service. Each company is capitalized at $5,000, and Congressman Greist, Lancaster, is one of the incorporators.

PROVIDENCE, R. I.—The Rhode Island Pwr. Trans. Co. has been organized by interests identified with the Connecticut River Trans. Co., which operates a generating and distributing system in central Massachusetts and southern Vermont, for the purpose of supplying electricity in Rhode Island in connection with the Connecticut River system. The officers are: Malcolm G. Chace, Providence, president; John O. Ames, vice-president, and W. W. Brooks, treasurer.

DALLAS, TEX.—The Texas El. Co. has been chartered with a capital stock of $100,000 by A. Ragland, J. V. Watkins, J. J. Metcalf and others. The company proposes to build an interurban electric railway from Palestine to Austin, via Dallas. J. V. Watkins, Dallas, is president.

BIG STONE GAP, VA.—The Virginia Hydro-Electric Co. has been incorporated with a capital stock of $10,000. The officers are: J. R. Paull, Pittsburgh, Pa., president; J. B. Cox, Johnson City, Tenn., vice-president; F. M. Butler, Big Stone Gap, treasurer.

FAIRMONT, W. VA.—The Monongahela Valley Trac. Co. has been formed with a capital stock of $7,500,000 and the following officers: S. L. Watson, Fairmont, president; J. H. Wheelwright, Baltimore, vice-president; Walton Miller, Fairmont, secretary and treasurer; J. O. Watson, general manager, and Smith Hood, Fairmont, general superintendent. The company is a consolidation of the Fairmont & Clarksburg Trac. Co., the Fairmont & Northern Trac. Co. and the Clarksburg & Western Street Ry. Co. Arrangements will be made by the company to complete the Clarksburg and Weston line and to build a railway from Clarksburg to Salem, W. Va.

OAKFIELD, WIS.—The Oakfield Lt. & Pwr. Co. has been incorporated with a capital stock of $10,000 by F. B. Worthing and others.

OCONOMOWOC, WIS.—The Oconomowoc River Pwr. Co. has been granted a charter with a capital stock of $30,000. The incorporators are: B. E. Sivyer, H. H. Walters and N. Tyrell.

Trade Publications

WATER-FLOW METERS.—Bulletin No. 4941 published by the General Electric Company is devoted to a description of the G. E. water-flow meters and supersedes the last previous bulletin on the subject.

ELECTRICITY IN METAL MINES.—Bulletin No. 4922 issued by the General Electric Company is devoted to electricity in metal mines. The bulletin illustrates and describes several modern installations of electric mining machinery.

BATTERY-CHARGING RHEOSTATS.—The General Electric Company's Bulletin No. 4934 is devoted to a description of battery-charging rheostats known as type CR-211, and illustrates the company's latest equipment for this character of service.

ENGINEERING CATALOGS.—The Regina Engineering Society, Regina, Sask., Canada, is arranging a catalog file for the use of its members and is soliciting additions therefor from manufacturers. Mr. Edgar T. Wenger is librarian of the society.

PUMPS.—Considerable data on the operating characteristics of pumps are given in Bulletin No. 112 of the Goulds Manufacturing Company, Seneca Falls, N. Y. The bulletin contains all of the instructions and data needed in estimating on pumping installation.

INSULATOR CLAMPS.—Bulletin No. 1 issued by the Clark Electric & Manufacturing Company, of New York, illustrates the Clark standard insulator clamp, showing an application on standard pin-type insulators. Clamps of this type are in use on a number of transmission systems.

STEEL-TAPED CABLES.—The Simplex Electrical Company, 201 Devonshire Street, Boston, Mass., has issued an illustrated booklet giving many valuable data relating to the costs of steel-taped as compared with lead-covered cable. The power is laid without conduits on manholes.

MOLDED INSULATION.—The insulators used on the under-running third-rail system of the New York Central Railroad are described in a circular issued by the Boonton Rubber Manufacturing Company, Boonton, N. J. The circular includes results of some comparative tests.

FANS AND MOTORS.—The annual catalog of the Hunter Fan & Motor Company, Fulton, N. Y., just issued, contains a complete list of ceiling and floor-column fans, self-oiling countershafts, shaft hangers, pulley stands, belt carriers, etc., together with prices and other information.

RESISTANCE MATERIALS.—The Driver-Harris Wire Company, of Harrison, N. J., has issued a new booklet, known as Catalog J, describing its various resistance materials. This catalog gives both resistance tables and price lists and will be found generally useful to all who have occasion to employ resistance materials.

ELECTRIC-VEHICLE MOTORS.—No. 6 of the series of circulars on small motors published by the Westinghouse Electric & Manufacturing Company deals with electric-vehicle motors. Besides the technical description of this class of motors the circular also discusses the commercial car as a central-station revenue producer.

COPPER SPLICING SLEEVES.—The Clark Electric & Manufacturing Company, of New York, recently distributed Bulletin No. 8, describing its sleeves for splicing hard-drawn copper wires and cables. These sleeves are made of pure seamless copper tubes, oval in shape, to fit any conductor specified. Special tools are required for making joints.

ELECTRIC VEHICLES.—The General Vehicle Company, Long Island City, N. Y., has issued a striking folder illustrating the fact that if the 1037 electric vehicles which the company has sold in New York City alone were placed one on top of the other they would reach a height of 9000 ft., or twelve times that of the highest building in the world.

SECTIONAL CONDUIT.—Catalog No. 112, distributed by the H. W. Johns-Manville Company, describes the J-M sectional conduit system for insulating underground pipes which convey steam, water, gas or liquids. This publication contains data of interest to all who install or operate underground distribution systems for furnishing steam or hot-water heating service.

BATTERY-CHARGING SWITCHBOARD.—A recent bulletin issued by the Electric Storage Battery & Manufacturing Company, of Cincinnati, Ohio, describes its switchboard for charging storage batteries for ignition and lighting service. This bulletin illustrates a small self-contained panel equipped for 110-volt supply on either alternating-current or continuous-current service.

RESISTANCE-THERMOMETER EQUIPMENTS.—A bulletin issued by the Leeds & Northrup Company, 4901 Stenton Avenue, Philadelphia, Pa., describes seven equipments of thermometers and pyrometers installed by this company. Each illustrates some particular feature possessed by temperature-measuring devices of the resistance type as contrasted with other methods.

CONSTRUCTION MATERIALS.—The Kellogg Switchboard & Supply Company, of Chicago, has issued Bulletin No. 60, which is a catalog of construction materials, tools and miscellaneous supplies. The book relates more especially to the construction and maintenance of telephone lines, but much information is given of interest to all having to do with overhead construction.

SMALL SWITCHBOARD PANELS.—A recent bulletin has been distributed by the General Electric Company entitled "Isolated and Small Plant Alternating-Current Switchboard Panels," numbered 4944. The type of panel described in this bulletin is indicated under the title, the limit of capacity being 1500 kva. Numerous illustrations are given showing dimensions and connections.

SOLDERLESS CONNECTORS.—Dossert & Company, 242 West Forty-first Street, New York, N. Y., have issued Catalog No. 5, containing price lists, code words and other information regarding the Dossert solderless connectors for solid and stranded wires. The different types are illustrated and the use for which each connector is intended is described. Dimensions of all standard connectors are given.

INCLOSED-FUSE PROTECTIVE DEVICES.—Catalog No. 406, issued by the H. W. Johns-Manville Company, describes the Noark inclosed-fuse protective devices and is a comprehensive book of 330 pages. It describes a large variety of fuse mountings and boxes, giving dimensions, ratings and list prices. It will be of interest and use to wiring contractors and all who have charge of wiring installations.

VACUUM CLEANERS.—The Vacuna Sales Company, 30 Church Street, New York, N. Y., has issued a descriptive circular of the Vacuna vacuum cleaner. This is built on the turbine principle and is claimed to possess the particular feature of maintaining a constant vacuum under all conditions independent of the amount of air moved and irrespective of whether or not the tool is open or closed.

COMBINATION TELEPHONES—The so-called combination telephone has not received the attention and widespread use it deserves, in view of the advantage of having a transmitter and receiver mounted on a common handle with a total weight of only 21 ounces. This convenient type is well described and illustrated in a pamphlet issued by the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y.

RAILWAY MOTOR CARS.—The Chicago Pneumatic Tool Company, Fisher Building, Chicago, and 50 Church Street, New York, has published Catalog No. 40, describing the "Rockford" railway motor cars, equipped for both hand and gasoline motor propulsion. These cars are furnished in several capacities up to a load of ten men and tools. All styles are adapted for speeds of from 3 miles to 20 miles per hour.

TACHOMETERS.—James G. Biddle, 1211 Arch Street, Philadelphia, has issued Bulletin No. 750, entitled "Frahm Vibration Tachometers." It contains information concerning these resonance instruments, which are proving popular for use with steam turbines and other machinery that rotate at relatively high speeds. No gears, belts or electrical connections are required and the system is said to be "simplicity itself."

FIXTURES.—The Tungstolier Company, Conneaut, Ohio, has issued the first of a series of publications designated as "The Fixtureman," and devoted chiefly to business hints for the electrical contractor who handles fixtures and the central-station man with a wiring and equipment department, as well as for the dealer who handles fixtures exclusively. The publication is patterned after the *Philistine* magazine.

DIRECT-CURRENT MOTOR-STARTING PANELS.—Bulletin No. 4943, recently distributed by the General Electric Company, illustrates and describes direct-current motor-starting panels, designed especially for heavy service in steel and cement mills. The equipment is strongly constructed and liberally proportioned and is also provided with safety adjustments which render it safe and reliable in the hands of unskilled operators.

MECHANICALLY DRIVEN OIL PUMPS.—The Bosch Magneto Company, 223 West Forty-sixth Street, New York, N. Y., has issued two well-illustrated 12-page pamphlets on the subject of mechanically driven oil pumps for force-feed lubrication. Descriptions are given of two types, "A" and "AC," which differ in the "sight-feed" equipment. The pamphlets also contain information pertaining to the installation, care and maintenance of the oilers.

ELECTRICAL SUPPLIES.—The Acme Electric Company, Knoxville, Tenn., has issued a pamphlet containing price lists of electrical machinery and supplies and calling attention to the facilities of the company for designing and contracting. It also includes diagrams of various installations, such as fire-alarm systems, combination lighting and heating plant, pumping plant, electrical apparatus of different kinds designed by the company, etc.

INDUSTRIAL LIGHTING FIXTURES.—Bulletin No. 120, recently published by the Tungstolier Company, of Cincinnati, Ohio, describes the new Tungstolier weather-proof industrial lighting unit recently placed on the market. This unit is specially designed to meet the demand for a weatherproof fixture which can be used for fixture lighting under conditions of weather exposure, and it is also suitable for use in interiors. Copies can be obtained upon application.

ELECTRIC TIME STAMPS.—The electric time stamp magnetograph manufactured by the Magneta Company, 1955 Park Avenue, New York, N. Y., is described in a circular recently issued by this company. These stamps are for use in large offices and institutions where it is of importance that all stamps should record uniform time. The stamps are electrically operated by one master clock, and any number of stamps, irrespective of location, will always print uniform time.

CIRCUIT-BREAKERS.—Folder No. 4049 issued by the Westinghouse Electric & Manufacturing Company describes its type F circuit-breakers, designed for 250 volts direct current and 440 volts alternating current. These circuit-breakers are equipped with carbon breaks and made in several styles, including automatic overload release, automatic overload release with shunt trip coil, and non-automatic with shunt trip. Reverse-current trip and over-voltage trip features can also be provided.

Business Notes

ALBERGER PUMP COMPANY.—The Isthmian Canal Commission has awarded a contract to the Alberger Pump Company, New York, for 145 pumps to be used in the miter gates at the locks of the Panama Canal.

L. F. HARZA & COMPANY have opened offices in the Lewis Building, Portland, Ore., for practice as consulting, designing and supervising engineers on hydroelectric, irrigation, municipal water supply, sewerage and general engineering work.

THE CENTRAL TUBE COMPANY has opened general sales offices in the Lewis Building, Pittsburgh, Pa., for handling its own rigid black and galvanized iron conduit and armored conductor flexible conduit. Mr. Alex. Laughlin is president, Mr. G. S. Pease secretary, and Mr. W. F. Ingals general manager of sales for the company.

WAVERLEY COMPANY.—Recent orders placed with the Waverley Company include one for a 2-ton truck from the Fleischman Company, which ordered twenty delivery wagons a short time ago to be used for delivering yeast. These cars are now in service. A number of department stores, including Mandel Brothers, of Chicago, and the Hibben-Hollweg Company, of Indianapolis, have recently installed Waverley vehicles for delivery service.

THE AMERICAN ENGINEERING COMPANY, which manufactures the Taylor stoker, has recently filled orders for stokers from the following: Berkshire Street Railway Company, Zylonite, Mass.; Consolidated Gas, Electric Light & Power Company, Baltimore, Md.; Potomac Electric Light Company, Washington, D. C.; Interborough Rapid Transit Company, New York, N. Y.; Cambria Steel Company and the New York Central Railroad, Port Morris, N. Y.

THE STANDARD VARNISH WORKS, for many years located at 29 Broadway, New York, have removed to their new office building at Elm Park, Port Richmond, Staten Island, N. Y. The new quarters will be four stories high. The first and second floors will be devoted entirely to office purposes. On the third floor have been installed dining-rooms for the accommodation of all the employees and a complete printing and stationery department and janitor's quarters. The fourth floor has been equipped as an up-to-date chemical research laboratory.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 14, 1912.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,025,992. TRANSMITTER FOR TELEPHONIC OR AUDIPHONIC SYSTEMS; H. G. Pape, Buffalo, N. Y. App. filed Jan. 3, 1910. Has a spacing diaphragm.

1,026,003. CIRCUIT OPENING AND CLOSING SWITCH FOR CHARGING CIRCUITS; A. J. Stecker, Detroit, Mich. App. filed April 28, 1909. For automobile lighting and ignition systems.

1,026,029. SELECTIVE ELECTRICAL SIGNALING SYSTEM; C. L. Goodrum, Philadelphia, Pa. App. filed Aug. 8, 1903. Party-line telephone.

1,026,057. MICROPHONE; H. E. Shreeve, Wyoming, N. J. App. filed Sept. 2, 1909. Transmitter for the use of the deaf.

1,026,150. ELECTRIC WAVE TRANSMISSION; J. H. Cuntz, Hoboken, N. J. App. filed April 14, 1905. Means for increasing permeability of magnetic cores.

1,026,151. SERVICE-METER CIRCUITS; H. D. Currier and G. Wolf, Chicago, Ill. App. filed Nov. 7, 1907. To prevent repeated registration.

1,026,158. X-RAY FINDER; A. Granger, New Orleans, La. App. filed Sept. 19, 1911. To enable an operator to find the normal X-ray.

1,026,160. INDICATING RINGING KEY; W. E. Harkness, East Orange, N. J. App. filed April 14, 1909. Selective party-line key for switchboards.

1,026,164. SWITCH OR JUNCTION BOX; O. C. Hoffmann, Buffalo, N. Y. App. filed Dec. 9, 1911. Adjustable connection with a face plate, etc.

1,026,183. CIRCUIT-CONTROLLING KEY; H. E. Shreeve, Millburn, N. J. App. filed Oct. 19, 1911. A telephone switchboard switching key.

1,026,196. WATCHCASE RECEIVER; W. O. Beck, Weehawken, N. J. App. filed Aug. 10, 1910. Telephone receiver of watchcase type.

1,026,197. METALLURGICAL FURNACE; G. H. Benjamin, New York, N. Y. App. filed Aug. 17, 1911. Improves on the Hubner furnace. (See patents Nos. 899,403, 906,883 and 934,532.)

1,026,199. REVERTIVE-CALL-INDICATING MEANS FOR TELEPHONE EXCHANGE SYSTEMS; A. M. Bullard (deceased), New York, N. Y. App. filed June 4, 1909. For semi-automatic party-line systems.

1,026,200. RAILWAY BLOCK-SIGNALING SYSTEM; Y. Burgess, Chicago, Ill. App. filed Oct. 18, 1910. Closed-circuit system with signals in the locomotive cabs.

1,026,217. ELECTRIC WATER-HEATING DEVICE; H. Löfquist, Stockholm, Sweden. App. filed Oct. 14, 1911. A plurality of superposed annular metal casings containing heating elements.

1,026,231. AUDIPHONE TRANSMITTER; C. E. Williams, Chicago, Ill. App. filed Jan. 14, 1911. For pocket use.

1,026,238. ELECTRICAL CONNECTION; J. M. Anderson, Boston, Mass. App. filed Feb. 15, 1912. Socket and plug type with strain relief.

1,026,269. ATTACHMENT PLUG; G. C. Kanuff, Chicago, Ill. App. filed Nov. 20, 1911. Anchorage of the terminals.

1,026,281. ELECTRIC REFINING CRUCIBLE; J. H. Reid, Newark, N. J. App. filed July 19, 1911. The conductivity of the crucible is varied while in operation.

1,026,290. ALTERNATING-CURRENT PROGRAM SYSTEM; J. L. Wrenn, Washington, D. C. App. filed Jan. 17, 1912. Means for operating time stamps, secondary clocks, bells, etc.

1,026,296. AUXILIARY CARBON-CONTACT CIRCUIT-BREAKER; C. C. Badeau, Boston, Mass. App. filed July 27, 1909. Secondaries have minimum resistance when the main contacts are open.

1,026,297. PHOTOTELEGRAPHY; T. T. Baker, Cricklewood, England. App. filed Jan. 20, 1910. For reproducing halftones.

1,026,328. TELEPHONE SYSTEM; F. R. Parker, Chicago, Ill. App. filed Nov. 23, 1904. Signal indicators; supervisory control; no relays.

1,026,334. COOKING APPARATUS; R. B. Vessey, Flint, Mich. App. filed Sept. 26, 1911. "Fireless" cooker.

1,026,345. APPARATUS FOR TREATING FILAMENTS; W. D. Coolidge, Schenectady, N. Y. App. filed Feb. 13, 1907. Automatic machine for making and treating filaments of tungsten, etc.

1,026,363. ELECTRICALLY HEATED TOOL; L. F. Parkhurst, Pittsfield, Mass. App. filed July 13, 1908. Shoe-ironing tool with a removable heating unit.

1,026,364. SYSTEM OF CONTROL; K. A. Pauly, Schenectady, N. Y. App. filed April 19, 1910. Alternating-current and direct-current drive of rolling mills.

1,026,377. RESISTANCE UNIT; L. E. Barringer, Schenectady, N. Y. App. filed July 14, 1910. A porcelain tube with enameled metal lining and an external resistance helix.

1,026,382. METAL FILAMENT; W. D. Coolidge, Schenectady, N. Y. App. filed May 9, 1906. Cadmium-bismuth alloy containing tungsten.

1,026,384. METAL FILAMENT; W. D. Coolidge, Schenectady, N. Y. App. filed Sept. 23, 1908. Cadmium, bismuth, mercury, tungsten and cupric oxide.

1,026,388. MAST FOR WIRELESS TELEGRAPHY; O. Fricke, New York, N. Y. App. filed Feb. 20, 1912. Has a counter-balanced pendulic tip supporting antennas.

1,026,391. VOLTAGE TRANSFORMATION; M. R. Hanna, Schenectady, N. Y. App. filed Nov. 23, 1911. A plurality of rotary transformers having their windings connected so as to divide the voltage.

1,026,392. INCANDESCENT-LAMP FILAMENT; C. A. Hansen, Schenectady, N. Y. App. filed April 8, 1908. Tungsten powder and a binder of zirconium oxalate.

1,026,393. BURGLAR AND FIRE ALARM; J. Hartley, Philadelphia, Pa. App. filed April 20, 1911. Adapted to be operated by an opening door.

1,026,414. ANTISEPTIC MOUTHPIECE FOR TELEPHONES; F. C. Tabler, St. Louis, Mo. App. filed July 10, 1911. An absorbent web is mounted in the mouthpiece.

1,026,415. AUTOMATIC STEERING DEVICE FOR FLYING MACHINES; R. M. Thompson, Tacoma, Wash. App. filed June 29, 1910. A compass and adjustable controlled mechanism.

1,026,428. TUNGSTEN PURIFICATION; W. D. Coolidge, Schenectady, N. Y. App. filed Sept. 23, 1908. Iron is removed by firing in a vacuum to a temperature below the fusing point of tungsten.

1,026,429. REFRACTORY CONDUCTOR; W. D. Coolidge, Schenectady, N. Y. App. filed Aug. 1, 1906. A refractory powder is compressed and impregnated with a ductile metal, which is then vaporized by heat.

1,026,456. MACHINE FOR SEALING THE ENDS OF METALLIC TUBES; G. G. Rambaud, New York, N. Y. App. filed Feb. 19, 1912. Electric soldering or welding of the ends of collapsible tubes.

1,026,503. SANITARY TELEPHONE MOUTHPIECE; C. V. Fuller, Newark, N. J. App. filed July 20, 1911. Removable paper lining.

1,026,518. ELECTRIC ALARM; W. J. Knoblock, Washington, D. C. App. filed Dec. 4, 1911. Alarm for a refrigerator drip pan.

1,026,527. PROCESS TO REGENERATE AND IMPROVE THE STRUCTURE OF LEAD ELECTRODES OF SECONDARY BATTERIES; E. H. Naylor, London, England. App. filed Dec. 27, 1910. Treated with sulphothionyl chloride.

1,026,552. LOCOMOTIVE; A. F. Batchelder, Schenectady, N. Y. App. filed Dec. 30, 1911. To prevent lateral swinging of the body of an electric engine.

1,026,564. ELECTRIC WATER-HEATER SYRINGE; H. M. Crawford, Lima, Ohio. App. filed Dec. 7, 1911. Automatic valve.

1,026,568. ELECTRIC-ARC LAMP; K. von Dreger, Berlin, Germany. App. filed June 30, 1908. A flaming arc with horizontal electrodes.

1,026,569. ELECTRIC-ARC LAMP; K. von Dreger, Berlin, Germany. App. filed June 17, 1909. A flaming arc with horizontal electrodes has a flame plate arranged above it.

1,026,611. ELECTRICALLY HEATED SYRINGE; M. H. Shoenberg, San Francisco, Cal. App. filed March 6, 1912. Hot-air syringe for dental and surgical use.

1,026,627. ELECTRODEPOSITION OF METALS; A Leuchter, New York, N. Y. App. filed Feb. 15, 1912. Electrotype plate of nickel and iron.

1,026,628. ELECTROPLATING; A. Leuchter, New York, N. Y. App. filed Feb. 15, 1912. An anode of nickel manganese with salts of the same in the bath.

13,420 (reissue). ELECTRODE FOR REVERSIBLE GALVANIC BATTERIES; W. Morrison, Des Moines, Ia. App. filed Nov. 15, 1910. A porous tube consisting of a series of cells of chromium compound. Original patent No. 975,981.